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2009
Annual Report on Flight Safety

Canada

DIRECTOR COMMENTS

This is the 5th Annual Report on Flight Safety for DND/CF. The report provides a synopsis of the investigations carried out by the Airworthiness Investigation Authority and the activities of the Directorate of Flight Safety. The report is divided in three parts: it provides an update on the Airworthiness Program related activities, describes the Flight Safety Program activities and analyses the 2009 Flight Safety data by comparing it with data from previous years. Of interest, the report introduces new statistical methodologies aimed at providing better perspective on the data presented.

Flight Safety is no different than many organizations in the Canadian Forces being pressured by personnel shortage and operational taskings. While being very well supported by the chain of command, the Flight Safety Program is feeling the impact of increased workload due to investigations in theatre of operations and oversight of more organizations contracted to support Canadian Forces flying operations. This is reflected by increasing numbers of Class I investigations and a larger number of facilities to survey. The number (3485) and the rate (249.8) of reported occurrences are the highest in the last 10 years. Given that occurrences with damage/injury have remained stable, this increase is indicative of an improving reporting culture.

The theme for the 2009 DFS Briefing Tour was appropriate for the current stressors facing the Canadian Forces: "Airworthiness in Operations". The reality of flying aircraft to their operating limits in demanding conditions with personnel taxed to the limit demands a vigilant and active Flight Safety Program. The Flight Safety Program is a "mission enabler" and gets its strength from the ethos of its members. The challenge remains for supervisors at all levels to be vigilant for the circumstances that might give rise to the risk for personnel injury and damage to aircraft.

Many initiatives have been put in place to improve the Flight Safety Program, two of them being the publication of the Airworthiness Investigator Manual and the development of a revised preventive measures (PM) tracking process. The articulation of effective PM is the objective in most of our activities. Improved procedures have been put in place to transfer the PM to the chain of command and monitor the progress of implementation of accepted PM. Hopefully, future reports will see a clear improvement in PM documentation with the result of very few PM remaining open after a 5-year implementation period.

//Original signed by//

G.R. Doiron
Colonel
Director of Flight Safety

EXECUTIVE SUMMARY

This report provides a synopsis of the activities carried out in 2009 by the Airworthiness Investigative Authority (AIA) and the Directorate of Flight Safety (DFS) in relation to the Flight Safety (FS) Program. It also gives statistical details on FS occurrence data collected during the year in comparison with the last ten years and highlights areas of concerns.

AIRWORTHINESS PROGRAM

Investigations. During the calendar year, the AIA initiated 27 investigations and closed 13. Relatively, the workload of the AIA has steadily increased in the last few years. The investigations mandated for 2009 were in relation to 15 accidents (2 category 'A' occurrences, 2 'B', and 11 'C'), 11 incidents (4 'D' and 7 'E') and 1 not categorized (non-CF). These figures include 3 Air Cadet investigations and 1 UAV accident investigation.

Aeronautics Act Amendment. The proposed Bill C-7 aiming to amend the Aeronautics Act was not re-introduced in the last Parliament. The Bill addresses AIA powers, sub-delegation, interaction with civilians, and confirmation of FS information privileged status.

Airworthiness Investigation Manual. The Airworthiness Investigation Manual (AIM), A-GA-135-003/AG-001 delineating AIA policies was released on 26 Nov 09. It outlines the basis for AIA standards, procedures and regulations, and details how the AIA interacts with persons, agencies, companies or authorities both within and outside of DND.

Amendments to A-GA 135-001/AA-001. Amendment #3 of the A-GA 135-001/AA-001, *Flight Safety for the Canadian Forces*, was drafted for approval. The proposed amendment covers changes relevant to the introduction of the AIM as well as describe the FS strategic business model, the CVR/FDR parameter requirements by families of aircraft, the conditions required to carry out airworthiness investigations, amends the investigation class table and illustrates the newly revamped occurrence/hazard PM management process.

CVR/FDR Working Group. The CVR/FDR Working Group continued its activities during the reporting period. The lack of immediate funds will preclude any fleet from meeting the standards laid out in the current CVR/FDR policy by the December 2010 deadline.

FLIGHT SAFETY PROGRAM

Promotion. DFS presented the annual briefing to 25 different locations covering all Wings as well as the Canadian Contingent at Geilenchirchen, CDLS (London) and SHAPE Brussels. DFS published 3 issues of *Flight Comment* magazine, 1 issue of *On Target* which focussed on human factors, 9 issues of the electronic FS newsletter *Debriefing* as well as 4 FS Flash messages. A total of 30 FS award nominations for individuals or groups were considered resulting in the granting of 7 *Good Show*, 14 *For Professionalism* awards and 9 recommendations' for Commanders Commendations.

Surveys. DFS conducted FS surveys with 5 contracted organizations: L3 MAS in Mirabel, Provincial Airlines in St. John's, Magellan Aerospace Corporation (Orenda) in Toronto, Bell Helicopter Textron Canada Ltd in Calgary, and Kelowna Flightcraft Limited in Kelowna. The 1 Canadian Air Division (1 Cdn Air Div) FS staff augmented with DFS personnel conducted surveys at 6 Air Force Wings: 1 Wing, 8 Wing, 14 Wing, 16 Wing, 17 Wing, and 19 Wing.

Training. A total of 6 Basic Flight Safety Courses were conducted by 1 Cdn Air Div FS staff which qualified 180 personnel; included 5 Army personnel, 16 Air Cadet Instructors, 2 foreign officers and 13 civilian contractors. 1 Cdn Air Div also conducted 2 Advanced Flight Safety Course (1 regular and 1 special) which qualified 28 personnel, including 1 Foreign and 1 contractor.

STATISTICS AND DATA ANALYSIS

Introduction of Standard Deviation in Trend Analysis. The goal of this trending methodology is to highlight areas of concern based on expectations. When comparing 2009 with the previous 10 years, results are calculated as the difference of 2009 data from the 10-year mean expressed in standard deviation units (Deviation coefficient).

Randomness Algorithm. The randomness algorithm introduced in 2008 assesses the level of randomness in the frequency of occurrences. It is specifically applied for HFACS Cause Factors and System Descriptors. A low level of randomness suggests a possible problem and will require further analysis to detect the cause of the pattern / problem. Used in conjunction with the Deviation coefficient value described above, it provides a better indication of how significant and reliable the data value is.

Flying Hours and Reporting. The overall number of hours flown in the CF and for the Air Cadet Glider Program (ACGP) remained relatively steady with Unmanned Aerial Vehicles (UAV) hours having tripled in 2009. Personnel reported 3,430 occurrences, of which 61% were classified as Air occurrences. This represents a significant increase in the rate of reporting per 10,000 hrs (270.7 compared to the 10-year average of 219.3) indicating a healthy reporting culture, in particular that the increase in reported occurrences was seen primarily where no damage and/or injury were present. The increase was mainly seen in the following fleets; CF188, CH146, CH147, CT102, CT146 and CU170.

Occurrences Breakdown. The CF had a less than favourable FS record with 8 personnel suffering major injuries, 3 of which were fatal and 5 serious. Further, a total of 2 aircraft were lost (1 CH146 Griffon and 1 CU161 UAV Sperwer). The Air accident rate for the CF was 0.75, attributable primarily to an increased number of C-category (serious damage/injury) occurrences distributed across a number of Air Force Fleets. This is greater than the 10-year average rate of 0.54, but improved over last year's rate of 0.89. On a positive note, the UAV accident rate was 1.59, a significant decrease from the 2008 rate of 80.2 in 2008.

System Descriptors. The report compares the numbers of aircraft system descriptor occurrences in order to determine the top three systems on each aircraft type that could be of concern. The rates were analysed to determine the relative validity of the information. For fleets representing concern areas, data was compared with information presented by the AIA at the Airworthiness Review Board including:

- CC115. Flares and pyrotechnics malfunctions contributed to the significant increase in Air Weapons System occurrences over the previous years.

- CH146. Twenty-four occurrences involving air weapons systems represent a significant increase over previous years. There are concerns about the stresses the CH146 is subjected to in deployed operations. RARMs have been published to mitigate the risk for VNE exceedances, roll limit exceedances, and vertical fin cracks. Another factor that was discovered while monitoring the HUMS data was numerous ITT exceedances during the summer of 2009.

- CP140. The increase in Other systems consisted mostly of smoke and fumes in the cabin. This points to possible deteriorating electrical systems in the aging airframe, and should be closely monitored in the future.

Personnel Cause Factor.

- Difference in Air and Ground Cause Factor Attribution. There is a marked difference in cause factor attribution for air and ground occurrences, most notably for 'Personnel' as a cause factor; 79.2% of ground occurrences involve a personnel cause factor, compared to only 42.4% of air occurrences. It is assessed the difference is attributable to the dissimilarity between the typical Air task and Ground task. Air operations rely primarily on an abundance of highly technical inter-related systems, whereas ground maintenance operations usually isolate the faulty system. Therefore, the Material component will appear relatively more often in Air operations in comparison to Ground Operations.

- High Percentage of Exceptional Deviations. It has been observed that Exceptional Deviations were outnumbering Routine Deviations when the reverse would be considered normal in a military culture flying context. DFS in conjunction with 1 Cdn Air Div FS staff is reviewing these deviations to determine if the preliminary findings are valid and what recommendations could be made as required to better train our investigators on the use of HFACS.

- Preventive Measures**.** There are still 43 PM developed in 2006 or earlier that are outstanding from aircraft accident investigations and 78 from incident investigations. A DFS mandated Working Group has recommended an improved tracking process that will be implemented in 2010.

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1. AIRWORTHINESS PROGRAM

1.1 AMENDMENT TO AERONAUTICS ACT (BILL C-7)

Bill C-7, as proposed, addresses several Department of National Defence (DND) airworthiness concerns. It includes additional powers for Airworthiness Investigation Authority (AIA) appointed investigators, better procedures for accident investigations dealing with civilian companies and the next-of-kin of personnel killed in CF aircraft accidents, confirmation of the privileged status of flight safety (FS) information, processes to enhance the conduct of DFS/Transportation Safety Board (Air) co-ordinated investigations and the ability to sub-delegate airworthiness authorities. Bill C-7 got to third reading and debate in the 39th parliament. The proposed amendments has not yet been re-introduced in the 40th Parliament.

1.2 AIRWORTHINESS INVESTIGATIVE MANUAL

This A-GA-135-003/AG-00Airworthiness Investigation Manual (AIM) was released on 26 Nov 09. The AIM outlines the basis for AIA standards, procedures and regulations and detail how the AIA interacts within DND/CF and with persons, agencies, companies or authorities outside of DND. It had an effective date of 16 Feb 10 and a compliance date of 15 Apr 10. The FS team is in the process of getting all formal certificates, authorizations and other governance items established before the compliance date. The AIM is available on-line via the DFS website at http://www.airforce.forces.gc.ca/dfs-dsv/index-eng.asp under Publications.

1.3 SURVEYS

Surveys are conducted to measure the effectiveness of the FS Program, to identify deficiencies that would otherwise have gone undetected, and to make recommendations for enhancements to this program with the intent of contributing to the production of an airworthy product. DFS conducted FS surveys at 5 contractor sites (L3 MAS in Mirabel, Provincial Airlines in St. John's, Magellan Aerospace Corporation (Orenda) in Toronto, Bell Helicopter Textron Canada Ltd. in Calgary, and Kelowna Flightcraft Limited in Kelowna) as part of the DFS continuous contractors visit program. FS staff from 1 Canadian Air Division (1 Cdn Air Div) augmented by DFS personnel conducted surveys at 6 different wings: 1 Wing, 8 Wing, 14 Wing, 16 Wing, 17 Wing, and 19 Wing.

1.4 WORKING GROUPS

1.4.1 CVR/FDR Working Group

The CVR/FDR Working Group continued to meet in 2009. Gap analysis and implementation plans were completed, with the exception of some contracted aircraft. A priority list for fleet fitment was developed by the AIA and agreed to by the 1 Cdn Air Div and 2 Cdn Air Div. Work began on drafting a revision to existing policy establishing the airworthiness requirements for CF operated aircraft to be equipped with on-board recording devices for the purpose of accident

prevention and investigation. The Director of Air Requirements is staffing a multiphase omnibus project to implement the CVR/FDR policy, with the aim of achieving an average of one fleet per year for the next 10 years based on the agreed upon fleet prioritizations. Unfortunately, no capital funding is anticipated to be available until 2014. The CVR/FDR Working Group has progressed as far as it can without funding approval. The lack of immediate funds will preclude any fleet from meeting the standards laid out in the current CVR/FDR policy. A revised policy is being formulated for CAS/AA consideration.

1.4.2 FS Occurrence Management System Working Group and Sub-working Group

The 4th Flight Safety Occurrence Management System Working Group (FSOMS WG) was held mid-February 2009 at the National Defence Headquarters in Ottawa. The FSOMS WG validated a PM/Hazard tracking capability in FSOMS. The operational specifications document for the FS Information Management System (FSIMS) was presented and endorsed. The WG reviewed and accepted a prioritised list of FSOMS software bug fixes. A proposal to align the CF current event and system descriptors with ICAO was presented. The proposal aims to enable a better representation of the event classification for trending purposes. New proposed taxonomies for Phase of Flight, Events and Systems Descriptors were also presented and endorsed. These descriptors are to be phased-in FSOMS V3.0.6, to be put into service in 2011.

1.5 CANADIAN JOINT HELICOPTER SAFETY ANALYSIS TEAM (JHSAT)

DFS participated in the analysis process of the JHSAT established by Transport Canada in 2007. JHSAT conducts the analysis of Canadian civil and military accidents with a goal to deliver a set of safety recommendations to the IHST and JHSIT. These recommendations will serve as the basis for developing implementation actions to reduce worldwide helicopter accidents by 80% by 2016. JHSAT has completed the analysis of the accident reports for year 2000 and is about to begin the analysis for year 2006.

1.6 INVESTIGATIONS

1.6.1 Investigation Summary

During the calendar year, the AIA initiated 27 investigations and closed 13. The investigations tasked by DFS were for 15 accidents (2 of category ‘A’, 2 of ‘B’, and 11 of ‘C’), 11 incidents (four of ‘D’ and 7 of ‘E’) and 1 not categorized (non-CF). These figures include 3 Air Cadet investigations and 1 investigation for a UAV accident.

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
CLASS I INVESTIGATIONS						
1	18 Jan 09	B	Very Serious	Nil	Chinook	Loss of Components
2	8 May 09	D	Nil	1 Minor	Non CF	Fouled Parachute
3	6 Jul 09	A	Destroyed	3 Fatal, 1 Serious, 1 Minor	Griffon	Helicopter Crashed on Departure
4	28 Jul 09	C	Serious	Nil	Cormorant	MGB Crack
5	13 Aug 09	E	Nil	Nil	Harvard II	Near Mid-Air Collision
6	6 Sep 09	A	Destroyed	2 Serious	SZ2-33A	Hard Landing. Assessed beyond economical repairs
7	17 Nov 09	E	Nil	Nil	Hornet	Training round landed within 50 feet of ground personnel
8	26 Nov 09	C	Serious	Nil	Buffalo	Damage During Refuelling
CLASS II INVESTIGATIONS						
9	5 Jan 09	C	Serious	Nil	Heron	Taxiway Incursion
10	28 Jan 09	D	Serious	Nil	Griffon	Mast Overtorque
11	28 Jan 09	D	Minor	Nil	Arcturus	Stabilizer Damaged During Tow
12	28 Jan 09	C	Serious	Nil	Griffon	Rotor Blade Contact Trees
13	6 Mar 09	C	Very Serious	Nil	Hornet	APU Started Without Duct
14	8 Apr 09	C	Serious	Nil	Hornet	Ground Collision
15	30 Apr 09	E	Nil	Nil	Griffon	HUMS Exceedances
16	13 May 09	C	Nil	Serious	Hercules	SAR Tech Injury
17	14 May 09	C	Serious	Nil	Hornet	Bird Strike
18	17 May 09	C	Serious	Nil	SZ2-33A	Wing Struck Taxiway Light
19	12 Jun 09	E	Nil	Nil	Tutor	Lap Belt came apart
20	24 Jun 09	D	Nil	Minor	Hercules	Technician Fall
21	7 Jul 09	C	Nil	Serious	Hercules	SAR Tech Jumper Injured on Landing

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
22	8 Jul 09	E	Nil	Nil	Hercules	Parachute malfunction during SAR Ops
23	3 Aug 09	E	Nil	Nil	Griffon	Rotor Droop
24	5 Aug 09	B	Very Serious	Nil	SZ2-33A	Glider Struck Trees
25	22 Sep 09	C	Serious	Nil	Griffon	Hard Landing
26	14 Oct 09	Pending	Pending	Nil	Royal Navy Merlin	Hard Landing on-board HMCS Montréal
27	19 Oct 09	E	Nil	Nil	Griffon	Runway Incursion

Table 1 - List of 2009 AIA Initiated Investigations

1.6.2 Investigation Details

1.6.2.1 18 Jan 09, Chinook CH147204, Accident, Cat 'B', Kandahar, Afghanistan

Chinook CH147204 was tasked on a training mission out of Kandahar airfield (KAF) and departed for the mission. Later in the morning, while the aircraft was still on its mission, maintenance personnel found an aft rotor fixed droop stop on the ramp near where that aircraft was previously parked.

The droop restraint system has no function while the aircraft is in flight and failure of the system does not impede safe flying operations. However, the droop restraint system supports the weight of the rotor blades on start-up and shutdown to prevent them from striking the fuselage.

The maintenance personnel immediately checked all other aircraft on the ramp and determined that none of the helicopters were missing a fixed droop stop. The Ops Center advised the occurrence crew of the situation and recalled the aircraft. Once safely in KAF, the aircraft was landed at a remote location away from personnel, buildings and other aircraft. Using a procedure borrowed from a coalition partner, a ladder/ramp was put in place to protect the fuselage from damage by the drooping blade. The crew set the parking brakes, secured the flight controls in place and exited the aircraft. The engines continued to run until the fuel supply was exhausted. After the engines stopped, the rotors began slowing down until they eventually impacted the

ramp, causing very serious damage to the rotor blade system and fuselage. There were no injuries. This investigation is on-going.

1.6.2.2 8 May 09, Non-CF, Incident Cat 'D' Fouled Parachute

The Canadian Forces School of Search and Rescue (CFSSAR) was conducting a basic Search and Rescue (SAR) technician trade qualification course. The student SAR technicians were to perform their first water landing from a parachute jump commencing from 3,000 feet above the water surface. The drop zone (DZ) was at the east end of Comox Lake, located approximately 10 NM southeast of 19 Wing Comox.

As the Jumper exited the aircraft the Life Raft Survival Kit (LRSK) interfered with the normal deployment of the main parachute. During the exit, the LRSK rolled inverted and rode up over the main parachute compartment. The Jumper's static line stretched tight in a normal manner and pulled the deployment bag (D-Bag) containing the main parachute from the parachute pack tray. The main parachute D-Bag fouled under the LRSK attachment strap preventing further main parachute deployment. The Jumper was now hung up and towed behind the aircraft by the taught parachute static line.

The Jump Master (JM) advised the pilot of the situation so the aircraft could be manoeuvred to remain over water. The JM quickly completed an assessment of the situation and after receiving the appropriate hand signal from the jumper, gave the order to the Safety Person to cut the Jumper's static line. The Jumper tried to stabilize in a belly down free fall attitude. He then attempted to cut away his main parachute and deploy his reserve parachute.

Following reserve parachute deployment, the Jumper noted little deceleration and that less than half the reserve canopy was inflated. The reserve parachute suspension lines appeared twisted but upon further examination, he noticed the main parachute inner D-Bag with extended suspension lines had wrapped around the reserve parachute suspension lines. The Jumper retrieved the D-Bag and swung it in a direction to unwrap it from the reserve parachute suspension lines. The reserve canopy began to inflate and slow his descent. The Jumper noticed the water surface approaching and he prepared for the water landing. At first contact he skipped off the water surface and then was thrown forward, landing in the water much harder than normal. A water rescue boat was immediately on the scene and operators assisted the Jumper into the boat. The Jumper received minor injuries. The on-going investigation is focusing on the

design of the LRSK.

1.6.2.3 06 Jul 09, CH146434, Accident, Cat 'A', Forward Operating Base, Afghanistan

The mission was part of the Joint Task Force (Afghanistan) Air Wing. It involved two CH146 Griffon helicopters tasked to carry two passengers each for a morning insertion to a Forward Operating Base (FOB) and afternoon extraction. The morning portion of the mission was conducted without incident.

The accident occurred during the extraction and involved the second aircraft in the formation (CH146434). The crew consisted of two pilots, one Flight Engineer (FE), and one Door Gunner (DG) with two passengers; one Canadian and one coalition soldier.

The lead aircraft landed first and picked-up its two passengers. On take-off, it cleared the HESCO barrier (fabric-lined metal mesh structure filled with sand and gravel) by approximately ten feet, and informed the other crew that maximum power available would be required. The second aircraft landed and picked up the two remaining passengers.

The occurrence crew developed their take-off plan which would be executed in two phases: a max performance take-off to maximize vertical obstacle clearance followed by an Instrument Take-off (ITO) once visual ground references were lost. The Flying Pilot (FP) pulled collective to 95% mast torque for the max performance take-off. Conscious of the high temperature of the day, just above 40^{o}C, the FP gave a quick crosscheck to the Inter-Turbine Temperature (ITT) gauge and noted a reading of 840-850^{o}C. At that moment the Non-Flying Pilot (NFP) called "Drifting Right". The FP's attention was immediately redirected outside to reacquire visual ground references, but a dust ball had obscured all visual cues, so the FP transitioned to instrument flight. The NFP made a second "Drifting Right" call, but just as the word "Right" was spoken, the aircraft hit the HESCO barrier.

The aircraft hit the barrier located at the one to two o'clock position, breaking the right-hand pilot's windscreen. The impact point was between the aircraft nose and forward of the right pilot door. On impact, the tail pitched up and simultaneously the aircraft rotated approximately 90 degrees counter-clockwise and rolled onto its right side, catching fire almost immediately. One pilot was uninjured and the other suffered only minor injuries. They were able to evacuate the aircraft through the shattered windscreen. The Canadian passenger, despite serious injuries, followed the pilots out. The two pilots attempted to provide assistance to the personnel still

inside the helicopter, but the post-crash fire precluded them from rendering assistance. The coalition soldier, the FE, and the DG perished in the accident.

No pertinent aircraft technical deficiencies have been discovered to date. The on-going investigation is focusing on Human Factors, mission planning and performance limits for Desert Operations and obscuring phenomena. Rear cabin evacuation and survivability is also under investigation.

1.6.2.4 28 Jul 09, CH149910, Accident, Cat 'C', Gander, NL

The occurrence aircraft, Cormorant CH149910, landed in Port au Choix, NL after having flown a 3-hr training flight. A significant amount of oil was discovered on the starboard side of the aircraft in the vicinity of the no. three engine. After discussion between the crew and maintenance personnel, the affected area was cleaned, the engine was replenished with oil, and a ground run was conducted. On the return flight, oil was again seen leaking along the starboard side from the vicinity of the same engine, which led the crew to shutdown the engine in flight. The aircrew conducted a two-engine running landing, taxied in and shutdown. The aircraft was put in maintenance to change the no. three engine. The engine change, ground run and maintenance test flight (MTF) proceeded as planned with no abnormalities. After the MTF, upon towing the aircraft in the hangar, oil was once again noticed on the starboard side. Initial inspection revealed considerable oil near the connecting intermediate transmission casing forward of the no. three engine bay, between the engine input shaft and the main gear box. Further inspection revealed a crack approximately 18.5 inches in length on the intermediate case of the no. three mechanical drive assembly.

The preliminary investigation has revealed that the aircraft damage was limited to the no. three main gearbox power train system, specifically the intermediate case of the no. three mechanical drive assembly connecting the MGB to the no. three engine. The fracture in the intermediate transmission case outboard flange of the no. three mechanical drive assembly spanned more than half of the circumference of the casing.

The on-going investigation is focussing on the engineering aspects; specifically design, manufacturing and loading of the no. three mechanical drive assembly

1.6.2.5 13 Aug 09, CT156101, Incident, Cat 'E', Moose Jaw, SK

The incident involved three CT156 Harvard II training aircraft. The first aircraft was on a clearhood dual mission with the student in the front seat. The two other aircraft were a formation, with "lead" having a crew of two and flown by an instructor in the front seat. Number 2 was a dual flight with the student in the front seat. CT156101 nearly collided with the CT156 traffic in the Moose Jaw Training Area. The aircrew assessed the miss distance at less than 100 feet.

The on-going investigation is focusing on multiple contributing factors, including but not limited to airspace management and flight operations procedures. 2 CFFTS has enhanced the role of the operations desk in assigning airspace. Other preventive measures (PM) recommended include further segregating 15 Wing Airspace and pursuing an electronic based collision avoidance system for 15 Wing aircraft.

1.6.2.6 06 Sep 09, Glider C-FNWO, Accident, Cat 'A', Kakabeka Falls, ON

Air Cadet Glider C-FNWO, a single Schweizer 2-33A glider, experienced a hard landing during the fall gliding program at the North-Western Ontario Gliding Centre (NWOGC) located at the Pineview Airpark. The two occupants sustained serious injuries. The aircraft was damaged beyond economical repairs. The investigation is on-going.

1.6.2.7 17 Nov 09, CF188925, Incident, Cat 'E', Salina, KS

CF personnel were conducting a Forward Air Controller (FAC) course using a ground laser designator to guide a Laser Guided Training Round (LGTR) to a range target located approximately 790 meters south. A LGTR released from Hornet CF188925 landed within 50 feet of ground personnel. The incident occurred at night on the Smokey Hills Range during the first delivery. The ground party consisted of FAC instructors and students with the instructors operating the ground laser designator and performing FAC duties as a demonstration to the students. Using standard procedures and following pilot / FAC mutual confirmation of the correct target with infrared markers, the pilot was cleared for the attack run. However, instead of homing to the intended target, the LGTR impacted approximately 50 feet southwest of the laser designator and the ground personnel. There were no injuries and further training was terminated. The investigation is on-going.

1.6.2.8 26 Nov 09, CC115465, Accident, Cat 'C', Kelowna, BC

A Buffalo aircraft (CC115465) sustained serious structural damage while refuelling at a third line maintenance contractor facility. The occurrence aircraft was undergoing a complete maintenance overhaul referred to as a periodic inspection. As part of this procedure, the aircraft exterior was to be completely stripped and repainted; which was being completed in parallel with the overhaul of mechanical systems. During refinishing, adhesive backed metal aluminum tape was used to seal the fuel tank vents, as per normal procedures. The repainting task was only partially completed and the tape had not yet been removed, when the aircraft was scheduled for a fuel leak check as part of a parallel maintenance routine.

The Crew Chief had reviewed the Canadian Forces Technical Order (CFTO) pertaining to the fuel system and other systems, prior to commencing the leak check, which required the pressure refuelling of all tanks. The outer wing fuel tanks were filled without incident, but as the inner wing fuel tanks gauges were indicating approximately 3700 lbs of the total 4160 lbs capacity, a bang was heard, and shortly thereafter, fuel was seen pouring from the right inner-wing fuel tank trailing edge, near the retracted wing flaps. The fuel spill was contained with absorbent material but the aircraft sustained very serious damage to the center wing box assembly. There were no injuries.

The focus of the on-going investigation will be on the practicality and applicability of CC115 CFTO procedures with respect to simultaneous maintenance work processes. The maintenance procedures for other fleets will also be comparatively assessed.

1.6.2.9 5 Jan 09, CU170251, Accident, Cat 'C', Kandahar, Afghanistan

At dusk, a Tactical Uninhabited Aerial Vehicle (TUAV) Heron was being towed eastbound on Foxtrot taxiway by a small, 4 wheel-drive, 2-passenger, mule utility vehicle. Both headlights and an amber strobe light were illuminated on the mule while the Heron's navigation, strobe and taxi lights were on. Four ground crew members were riding in the mule, two in the vehicle seats and two sitting facing backwards on the hatch of the mule's cargo bed. A Security Forces (SF) pickup truck was travelling westbound towards the setting sun along Foxtrot's Motor Transit Route (MTR). The MTR consists of two lanes on the south side of Foxtrot's taxiway centerline and operates much like a two lane road.

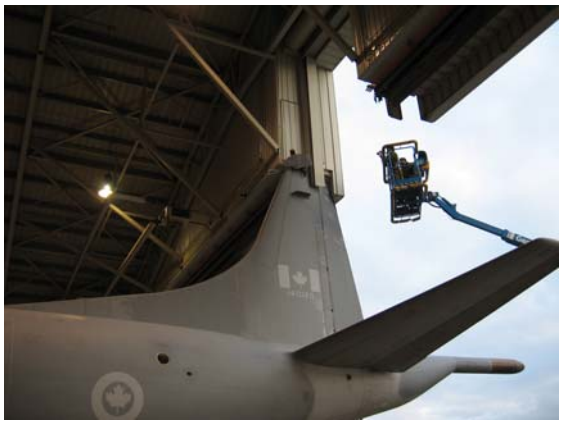
The SF vehicle collided with the right wing of the Heron. Upon impact, the Heron was pushed violently to the right; the right wing rode up the truck's windshield and along its roof and the left wing approached, but did not contact the personnel sitting in the back of the mule. The Heron sustained serious damage and the SF vehicle windshield was shattered. No one was hurt in the incident.

The investigation revealed that the SF driver saw the aircraft in tow only after the impact and the mule driver did not attempt any avoidance manoeuvres as he had right of way over the ground vehicle. Safety recommendations implemented included additional light sources on the Heron during night taxi and towing operations, revised taxiway procedures, and a change in the Heron Detachment's operating location. This investigation is complete.

1.6.2.10 28 Jan 09, CH146476, Accident, Cat 'D', Edmonton

The purpose of the flight was to conduct Night Vision Google (NVG) formation. The two CH146 Griffons were flying a training mission in the local area. The occurrence aircraft was number two in a two-plane formation. The helicopter had a significant mast overtorque during the overshoot from a snowball landing with the aircrew loosing references in re-circulating snow. The pilot pulled 117.43% mast torque to avoid contact with trees, exceeding the maximum allowable of 100 %. The investigation is on-going.

1.6.2.11 28 Jan 09, CP140120, Incident, Cat 'D', Comox, BC

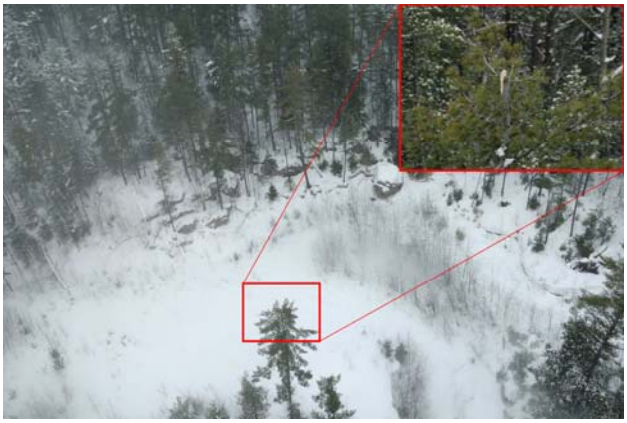


The incident occurred during the early morning hours as a tow crew of five personnel was pushing an Arcturus CP140 out of 12 Hangar. The tow crew supervisor took position adjacent to the tow bar on the right-hand side of the mule. There was no tail-walker assigned and the option of using one of the available personnel to cover the rear of the aircraft was not discussed.

As the aircraft began to move backward, it also drifted left undetected. The mule driver could not see the vertical stabilizer from the driver's seat and wing-walkers did not perceive that the vertical stabilizer was moving towards the side of the "doggy door" opening. The Tow Crew Supervisor also did not notice that the aircraft was drifting off the centreline and was positioned in such a way as to be too close to the aircraft and could not see the vertical stabilizer. As the aircraft moved rearward, the rudder and vertical stabilizer struck the top of the hangar door opening adjacent to the "doggy door", extensively damaging the rudder and vertical stabilizer tip cap and causing minor non-structural damage to the vertical stabilizer.

Safety recommendations implemented include the painting of CP140 main wheel guidelines on the floor of 12 Hangar, a review of scheduling and manning practices and a general audit of Squadron procedures. It was also recommended that this occurrence be used as an educational example for other maintenance organizations / tow crews. This investigation is complete.

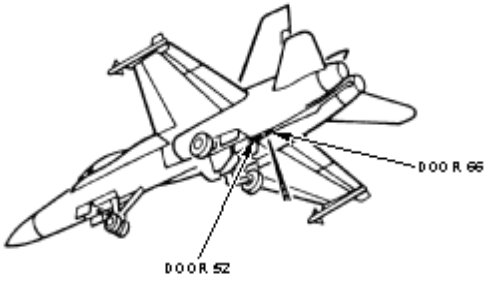
1.6.2.12 28 Jan 09, CH146470, Accident, Cat 'C', Petawawa, ON

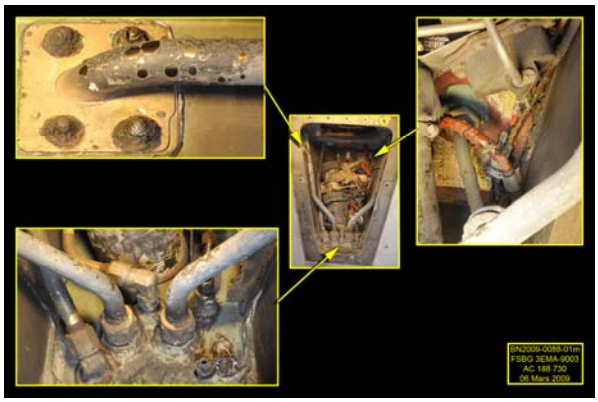


A Griffon Helicopter sustained serious damage to its main rotor when it contacted trees during Advanced NVG confined area training in the local flying area. The landing area was nearly rectangular and measured approximately 150 ft by 120 ft at ground level and was covered with fresh snow.

During the descent the pilot allowed the helicopter to drift and believed the helicopter tail rotor may have contacted a tree. The helicopter controls felt normal. The pilot manoeuvred the helicopter so he could look at the confined area from above. He noted a pine tree that would have been behind him in the area on the left side that had a fresh cut with the top branches missing. The helicopter was then flown directly back to the heliport and landed without further incident. A post flight inspection conducted by the FE found damage to the main rotor blades. The investigation is on-going.

1.6.2.13 5 Mar 09, CF188730, Accident, Cat 'C', Bagotville, QC





A maintenance contractor Periodic Augmentation Team (PAT) was conducting a ground run on the ramp to operate the hydraulic system of a Hornet. The aircraft was towed outside the hangar and the Auxiliary Power Unit (APU) was started. After less than two minutes of operation, one of the technicians outside the cockpit observed smoke from the APU area, and requested an emergency shutdown. The ground run operator immediately shut down the APU. The heat from the APU caused serious damage to the surrounding structure. Safety recommendations implemented include sending technicians for simulator training, inclusion of an aircraft status board for maintenance tasks, daily safety and quality briefings, and removal of all unauthorized / temporary checklists. This investigation is complete.

1.6.2.14 6 Apr 09, CF188762, Accident, Cat 'C', Tyndall AFB, FL

A Hornet was involved in a collision with an allied fighter aircraft. The CF188 was parked on the ramp in a host nation assigned parking spot and hit from the back/right by the other aircraft. Visible damage on the CF188 included the right hand Horizontal Stab and Station 9 LAU. The damage on the Hornet was assessed as serious. No injury was reported. The Allied Air Force is conducting its own investigation. The investigation has determined that no realistic preventive measures can be recommended to prevent this type of occurrence from happening. This investigation is complete.

1.6.2.15 30 Apr 09, CH146474, Incident, Cat 'E', Afghanistan

A speed exceedence was reported on a Griffon helicopter while performing an escort mission with a CH147 Chinook helicopter. The occurrence aircraft was the section lead of a 2-ship formation. The exceedence occurred during a tactical transition from high to low altitude where the crew observed the airspeed at 130 Knots Indicated Airspeed (KIAS). The investigation is on-going.

1.6.2.16 13 May 09, SAR Tech, Accident, Cat 'C', Trenton, ON

Freefall parachutist training was being conducted in the late afternoon from a CC130 Hercules aircraft for a stick of four SAR Techs. The drop zone (DZ) was a gravel surface at Baker's Island. Streamers were dropped to assess the wind before the drop and a windsock was located at the DZ. The surface wind was assessed to be from the southeast at 12 to 14 knots, well below the maximum allowable wind speed for parachute training of 25 knots.

The occurrence Jumper was the third free-fall parachutist to leave the aircraft. In descent, he established a standard downwind pattern to the DZ to permit an into-wind approach and landing. After turning onto base leg, he recognized that the effect of the wind on his movement over the ground was greater than expected. He immediately turned towards the DZ but assessed he was going to land short. The area immediately below him was unsuitable for landing due to obstacles. With some last minute manoeuvring between tall trees, he landed on the sloped, paved road surface that circles the DZ and sustained a serious injury.

The investigation focussed on the Jumper's assessment of the wind, low level canopy handling characteristics and the effect of low level winds over confining terrain on the actual landing area. Safety recommendations implemented included briefing all SAR Techs on effect of wind on descent pattern, turbulence downwind of obstacles, and importance of alternate landing areas. This investigation is complete.

1.6.2.17 14 May 09, CF188921, Accident, Cat 'C', Cold Lake, AB

After shut down, bird remains were found on the left hand intake and left hand heat exchanger. Serious damage was observed in the engine and on the structure around the engine intake. The pilot did not have any indication of a bird strike at any time during the mission. Examination of the bird remains indicated that the damage was caused by high-speed impact with a Mallard Duck sometime during the flight. No bird hazard report was in effect at the time. Non-destructive testing (NDT) did not reveal any cracks. The investigation determined that no preventive measures could be recommended from this occurrence. The investigation is complete

1.6.2.18 17 May 09, Schweizer C-GDZF, Accident, Cat 'C', Niagara District Airport, ON

An Air Cadet glider conducting Air Cadet familiarization training sustained serious damage to its left wing after it struck a taxiway light during roll out following landing at the Airport. The investigation determined that the pilot elected to land on runway 24 and then attempt the taxi down taxiway B despite the winds being out of limits. The occurrence aircraft landed slightly on the fast side according to witnesses and turned the corner onto taxiway B. Once turning the corner it rolled for approximately 200 feet before the left hand wing contacted the double taxiway light located at the intersection of taxiways B and C, which rotated the glider to the left for about 180 degrees before coming to a stop. Safety recommendations implemented included amending the Air Cadet Gliding Program manual to clarify taxiing procedure, developing Risk Management training for the Program, and improving supervision. This investigation is complete.

1.6.2.19 12 Jun 09, CT114145, Incident, Cat 'E', Bagotville QC

A passenger was assigned to the left seat of a Snowbird Tutor aircraft in preparation for a practice air show mission to be flown out of the airport. The passenger, a qualified CF188 pilot, had completed the strap-in in accordance with the Aircraft Operating Instructions (AOI) procedures and assisted by a member of the groundcrew. With the assistance of a Snowbird ground crew member, the functional checks were successfully completed to confirm a positive lock. Prior to the arrival of the Snowbird pilot, the passenger shifted his position in the seat and felt the tension in the lap belt release. It was quickly apparent that the lap belt had come apart at the point where the left end of the metal tongue connects to the left side the lap belt, also referred to as the ballistic assembly. No injury and no damage were reported from this occurrence. The investigation is on-going.

1.6.2.20 24 Jun 09, CC130319, Incident Cat "D", Camp Mirage

The incident occurred in the evening while a maintenance crew was changing a propeller on a CC130 Hercules transport aircraft. The occurrence technician was assigned to complete the required Level A and independent checks. As the work progressed, the technician's physical state gradually worsened such that he had trouble walking and using the maintenance stands. The technician climbed a maintenance ladder and fell three feet to the ground. The member suffered a minor injury.

The investigation revealed that the member sustained injuries on at least three different occasions before the occurrence. The technician was repeatedly offered medical attention and ordered by his supervisors to report for medical attention. These orders were disregarded, and supervisors allowed the member to continue to work without restriction, knowing that he had not sought medical attention. Safety recommendations implemented included reminding personnel about their readiness responsibilities and for supervisors to direct individuals for medical attention when required. This investigation is complete.

1.6.2.21 7 Jul 09, SAR Tech, Accident Cat "C", Greenwood, NS

The parachute jump was in conjunction with a Team Lead evaluation and consisted of a single stick of four jumpers with a planned water landing. During the jump, the SAR Tech experienced a hard impact landing. Prior to the jump, streamers were dropped from 1500ft and the DZ winds were confirmed by the DZ party to be within limits. The SAR Techs executed the jump from 1500ft with the occurrence SAR Tech being last in the stick. The SAR Tech exited with a lean to the right, and upon entering the slipstream, began to spin. The parachute opened with four to five line twists and his initial descent was nearly vertical, with little transition toward the intended landing zone. Upon clearing the line twists, he found himself to be below jumper three with trees below him. Having confirmed that the parachute had steering capability, he aimed toward the intended water-landing zone. Upon realization that he did not have sufficient altitude to make it to the lake, he began looking for a suitable alternate landing site. He encountered difficulty turning at low altitude due to turbulence over the trees, and continued traveling downwind with considerable forward velocity. He made an aggressive turn at low altitude to land near a road between the trees and power lines, which were directly in his flight path. The sharp turn caused the parachute to partially collapse, and the SAR Tech fell the last 20 to 30 feet. He assumed the PLF position, and landed in a ditch beside the road. During the landing, he received impact trauma, resulting in a serious injury.

The investigation did not reveal any problems with the rigging, and concluded that the SAR Tech's unstable exit resulted in line twists that took a significant amount of time to clear. In addition, the total time required for the four jumpers to exit the aircraft resulted in an extended displacement from the DZ. When the SAR Tech's parachute fully deployed, he was too low to be able to make the water landing as intended. The investigation is on-going.

1.6.2.22 8 Jul 09, SAR Tech, CC130328, Incident, Cat 'E', Wabush, QC

After performing a standard exit from the ramp of a Hercules, the SAR Tech became aware that the right steering toggle had come displaced during deployment and was tangled around the left main riser. The jumper found himself in an aggressive right spin that had to be countered with deep left toggle inputs. Once the SAR Tech regained level flight, he was able to clear the tangled steering toggle and land without incident.

The on-going investigation is focussing on the parachutes and equipment used by the jumpers, the technical orders, the personal techniques and practices of the riggers and SAR Tech involved.

1.6.2.23 3 Aug 09, CH146423, Incident Cat 'E', Afghanistan

A Griffon helicopter's Main Rotor RPM (RRPM) drooped to 92.4 % during take off. The LZ was austere and dusty. The aircraft landed in the LZ without incident. Due to the dusty conditions in the LZ, on take-off the aircraft was placed in a one-foot hover in preparation for a Maximum Performance Take-Off (MPTO). During the T/O the crew lost visual references at approximately 10 feet above ground. At this time the Main RRPM drooped to 92.4% with the distinct sound of the rotor slowing down accompanied with the distinct low rotor tone. As the crew was committed because they had lost visual references, the flying pilot maintained 95% mast torque and 92.4% RRPM on the instruments until the aircraft eventually accelerated out of the dust ball and visual references were regained. The investigation is on-going.

1.6.2.24 5 Aug 09, Schweizer C-GCSK, Accident, Cat 'A', Bromont, QC

An Air Cadet glider hit trees while on final approach and was damaged beyond economical repairs. The glider took off from Runway 23 Left for a solo flight, the Student Pilot's sixth flight of the day. The turn from base to final was significantly delayed and resulted in the Student Pilot overshooting the extended centre-line and ending up aligned with the service road between the two runways. The Student Pilot attempted different Left and Right sideslip manoeuvres to regain centre line and ultimately entered the trees on the left hand side of the runway, approximately 340 feet short of the threshold. The pilot did not sustain any injury. The investigation is on-going.

1.6.2.25 22 Sep 09, CH146425, Accident, Cat 'C', FOB, Afghanistan

A Griffon helicopter sustained damage to its landing gear, wire strike protection system (WSPS) and internal structure as a result of a hard landing in a dustball condition at a FOB. The damage was assessed as serious. The investigation is on-going.

1.6.2.26 14 Oct 09, RN Merlin, EH101857, Incident, Cat 'N/A', HMCS MONTREAL

While participating in an anti-submarine warfare (ASW) mission, a Merlin helicopter landed short of the flight deck while attempting to land onboard a Canadian frigate. The aircraft approached the deck from the port side of the ship, moved laterally across and over the deck, and immediately went into a low hover position. It then initiated a descent for landing. The aircraft tilted back, aft and to the right as it settled on the deck. The crew heard the "Wave Off", but elected to remain on deck. The helicopter's right main landing gear came to rest on the quarter deck, the right lower rear fuselage came to rest on the aft portion of the flight deck and the left main wheels came to rest on the flight deck.

Some crewmembers exited the aircraft and started to lash it to the deck to minimize the possibility of roll over. The flight crew conducted a shutdown on the flight deck and evacuated the aircraft without further incident. The RN Flight Safety Accident Investigation Centre (RNFSAIC) is conducting an investigation. The investigation is ongoing.

1.6.2.27 19 Oct 09, CH146441/CH146479, Incident, Cat 'E', Vancouver Airport, BC

A formation of two Griffon helicopters, "Griffon 11" lifted off from helipad Alpha and departed as cleared northbound across runways 26L and 26R. Air Traffic Control (ATC) was unsure as to whether Griffon 11 was a single ship flight or a formation flight. Once the first aircraft crossed the runway, ATC cleared a fixed wing aircraft on the ground for takeoff. Prior to the fixed wing aircraft commencing its takeoff roll, the second Griffon in the formation was observed to be crossing the runway approximately ¼ NM in trail of Griffon 11. Tower contacted the lead aircraft and the call sign confusion was clarified as a formation of two. Mission was continued without further incident. The investigation is on-going.

1.6.3 Joint Investigations

The AIA participated in two coordinated investigations with the TSB (Air). One involved the crash of a civil registered aircraft (C-FOBX) on 30 Jan 09. The investigation was convened and led by TSB (Air) with DFS providing a member given that the post-crash response involved the Rescue Co-ordination Centre Trenton. The other investigation involved a traffic conflict with a Griffon helicopter operating out of Vancouver International Airport on 19 Oct 09 and was convened and led by DFS with TSB (AIR) participation.

1.6.4 Investigation Report Status

1.6.4.1 Table 2 outlines the status of ongoing investigations as of 31 Dec 2009. Definitions for SR, ESR, and FSIR can be found in terminology article 5.2.

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
29 Apr 07	CH149902	Engine #3 sprag clutch disengaged	ESR being drafted
16 May 07	CF188720	Uncontained turbine failure	FSIR being drafted
03 Jul 07	CU161021	UAV crashed during launch due to propeller breakage	Draft SR being staffed
30 Aug 07	CH149903	Main rotor head damaged during ground maintenance	ESR being staffed
31 Oct 07	CH149902	Extensive wear damage on swash plate found on daily inspection	ESR being staffed
17 Nov 07	CU161017	Main gearbox failure	Draft SR being staffed
19 Jan 08	CH146488	Near rollover and over torque	FSIR being staffed
06 Mar 08	CU161019	UAV struck excavator after launch failure	SR being drafted
06 Apr 08	CU161017	UAV failed to climb after launch	SR being staffed
18 Apr 08	CT155215	Engine failure during climb out and double ejection	Draft FSIR being staffed
05 May 08	CU161022	UAV crashed shortly after takeoff	SR being staffed
25 May 08	CU161016	Prop strike during launch	SR being drafted
22 Jul 08	CH149909	Bag of bolts found in #2 driveshaft.	ESR being staffed
09 Aug 09	CU161026	Parachute malfunction during recovery	Draft SR being staffed
22 Aug 08	CU161030	Engine failure	SR being drafted
06 Sep 08	C-GQYY	Premature rope release.	FSIR being staffed
09 Oct08	CT114065	Tutor crashed during photo mission.	FSIR being staffed
16 Oct 08	CH149915	Tree strike during night training.	ESR being staffed
05 Nov 08	CU161031	Engine failure with post-crash fire	SR being drafted
18 Jan 09	CH147204	Failed Droop Restraint	FSIR being staffed
28 Jan 09	CH146470	Tree strike during NVG Training	FSIR being staffed

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
28 Jan 09	CH146476	Overtorque while landing in snow	ESR being drafted
04 Feb 09	CT155205	Compressor Stall.	Treated same as CT155215
05 May 09	CH146474	VNE exceedances	ESR being drafted
08 May 09	SAR TECH	Fouled parachute while training	FSIR being staffed
06 Jul 09	CH146434	Aircraft crashed on departure	FSIR being drafted
07 Jul 09	SAR TECH	Serious injury while undergoing parachute training	ESR being staffed
08 Jul 09	SAR TECH	Parachute occurrence during SAR ops	ESR being staffed
28 Jul 09	CH149910	An 18-inch crack found on MGB	FSIR being staffed
03 Aug 09	CH146423	Rotor droop during dustball take-off	SR being drafted
05 Aug 09	C-GCSK	Glider hit trees on final approach	ESR being staffed
13 Aug 09	CT156101	Near collision	FSIR being staffed
06 Sep 09	C-FNWO	Glider hard landing	FSIR being staffed
22 Sep 09	CH146425	Helicopter hard landing	SR being drafted
14 Oct 09	MERLIN	Merlin helicopter lands short on deck	ESR being staffed
19 Oct 09	CH146479	Runway incursion	ESR being staffed
17 Nov 09	CF188925	Training round lands app 50 feet from ground personnel	Prelim FSIR being staffed
26 Nov 09	CC115465	Structural damage while refuelling	Prelim FSIR being staffed

Table 2 - Ongoing Investigation Report Status

1.6.4.2 Table 3 outlines the investigations that were closed during 2009.

ACCIDENT DATE	AIRCRAFT	DESCRIPTION	INVESTIGATION CLOSURE DATE
19 Jun 06	C-FZIQ	Glider damaged in high winds.	17 Jun 09
18 May 07	CT114159	Lap belt opened during inverted flight	06 Jul 09
15 Mar 08	CG146427	Door departed in flight	22 Jun 09

ACCIDENT DATE	AIRCRAFT	DESCRIPTION	INVESTIGATION CLOSURE DATE
02 Jul 07	C-GYAR	Runway overrun on landing	11 Mar 09
28 Jul 08	CC130344	Ramp strike on landing	12 Jun 09
09 Aug 08	C-FDXP	Low altitude tow rope release	25 Nov 09
03 Sep 09	CF188705	Planing Link Failure	14 Jul 09
05 Jan 09	CU170251	Vehicle/aircraft collision while being towed	01 Dec 09
28 Jan 09	CP140120	Aircraft struck hangar while being towed.	25 May 09
24 Jun 09	CC130319	Technician injured.	04 Dec 09
			SR RELEASED in FSOMS
09 Sep 07	CH146454	Overtorque	27 Jul 09
18 Aug 09	CU161007	Parachute Failure	9 Jun 09
14 May 09	CF188921	Bird Strike	08 Oct 09

Table 3 –Closed Investigation Report Status

2. FLIGHT SAFETY PROGRAM

2.1 PROMOTION

The DFS annual briefing and unit visits were used as a major mechanism to promote FS. The theme of this year's briefing was "Airworthiness in Operations". The presentation dealt with the implications to operations of technical, operational and investigative airworthiness. The presentation was offered to all Wings in addition to the Canadian Contingent at Geilenchirchen, CDLS (London) and SHAPE Brussels, for a total of 25 units. DFS published 3 issues of *Flight Comment* magazine and 1 issue of *On Target*, which focussed on human factors. A total of 9 issues of the electronic FS newsletter *Debriefing* as well as 4 FS Flash messages were released.

2.2 AWARDS

A total of 30 FS award submissions for individuals or groups were forwarded to DFS / 1 Cdn Air Div FSO, resulting in the granting of 7 *Good Show* and 14 *For Professionalism* awards. The other 9 nominations were recommended for a Wing Commander's Commendations. When compared to the previous reporting period, there were 4 fewer award nominations. There were no suitable nominations for the 2009 SICOFFA award.

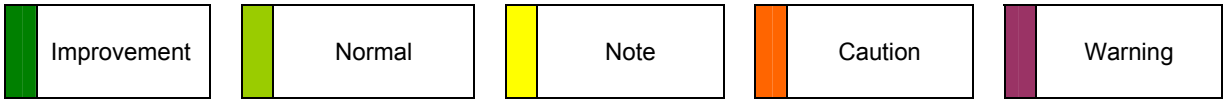
2.3 TRAINING

FS staff from 1 Cdn Air Div conducted 6 Basic FS Courses qualifying 180 personnel; included in the total number were 5 Army personnel, 16 Air Cadet Instructors, 2 foreign officers, and 16 civilian contractors. 1 Cdn Air Div also conducted 2 Advanced FS Course (one regular and one special) which qualified 28 staff, including 1 Foreign and 1 DND civilian.

3. STATISTICS AND TREND ANALYSIS

3.1 GENERAL

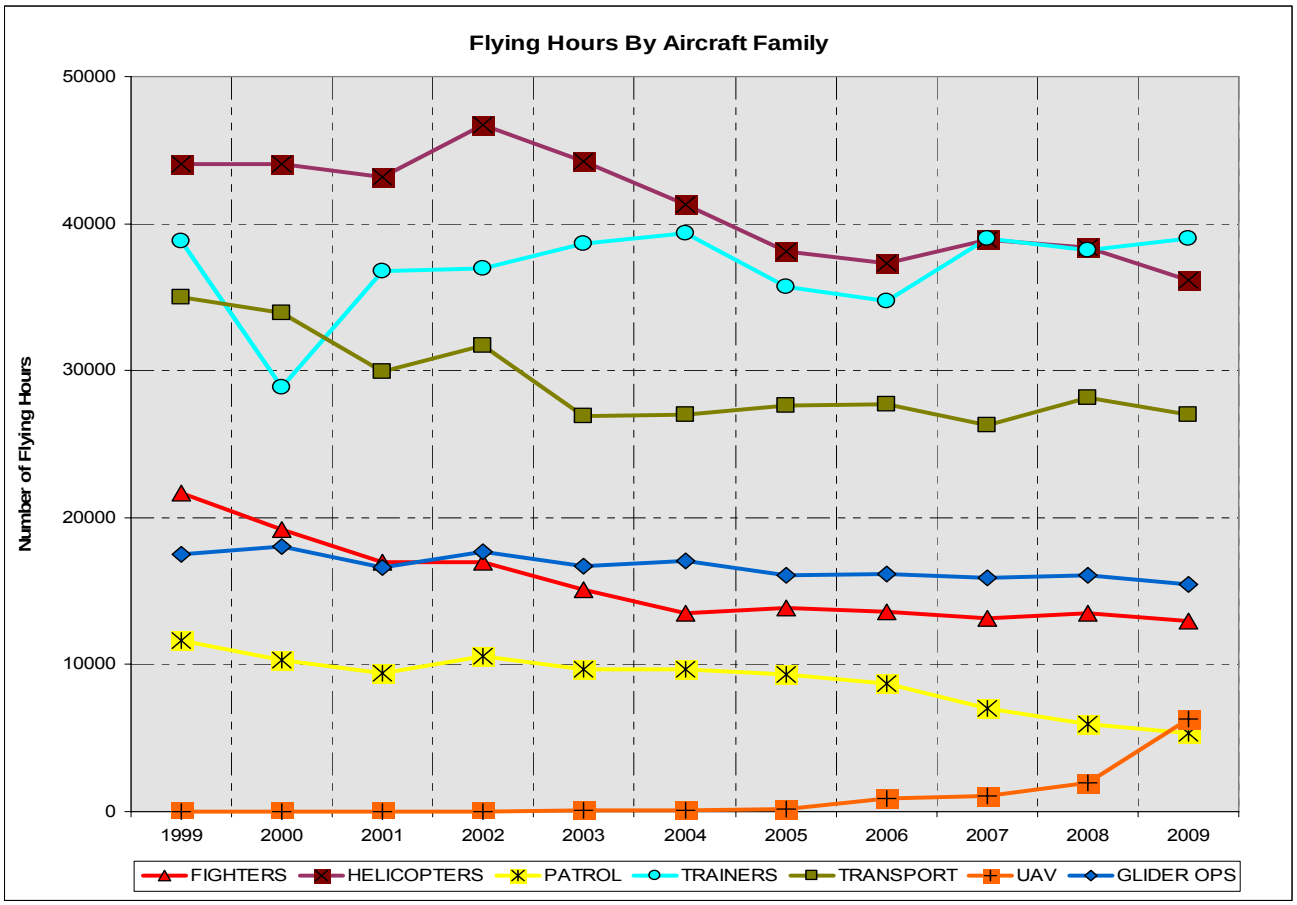
Rates are generally reported per 10,000 flying hours, except for HFACS classification, which is reported per 1000 occurrences. Data is classified according to the colour code shown below. The colour is derived from the difference between the 2009 value and the 10-year mean (unless otherwise stated), in multiples of the standard deviation. For any negative trend having a D value greater or equal than 3, it is colour-coded maroon. It represents values of highest concern (Warning) and requires detailed examination. If D is between 2 and 3 ($2<D\leq3$), it is colour-coded orange (Caution), and requires examination. If D is between 1 and 2 ($1<D\leq2$), it is colour-coded yellow (Note) and requires monitoring. When the dataset is not large enough to make a valid statistical inference, the D value is omitted (cell shaded Grey). Additional details can be found at Annex A. Further, randomness levels (RL) are provided for HFACS and system descriptor analysis. The randomness level determines if the trend is systemic and based on a valid data set. The combination of low randomness and colour shade of higher concerns warrants further examination of the data.



3.2 FLYING HOURS

3.2.1 Flying Hours by Aircraft Family and Type

The overall flying hours have remained relatively stable with no significant changes except for UAV hours, which more than tripled. Graph 1 displays the flying hours by aircraft family. Table 4 further subdivides the hours by aircraft type.



Graph 1 - Flying Hours by Aircraft Family

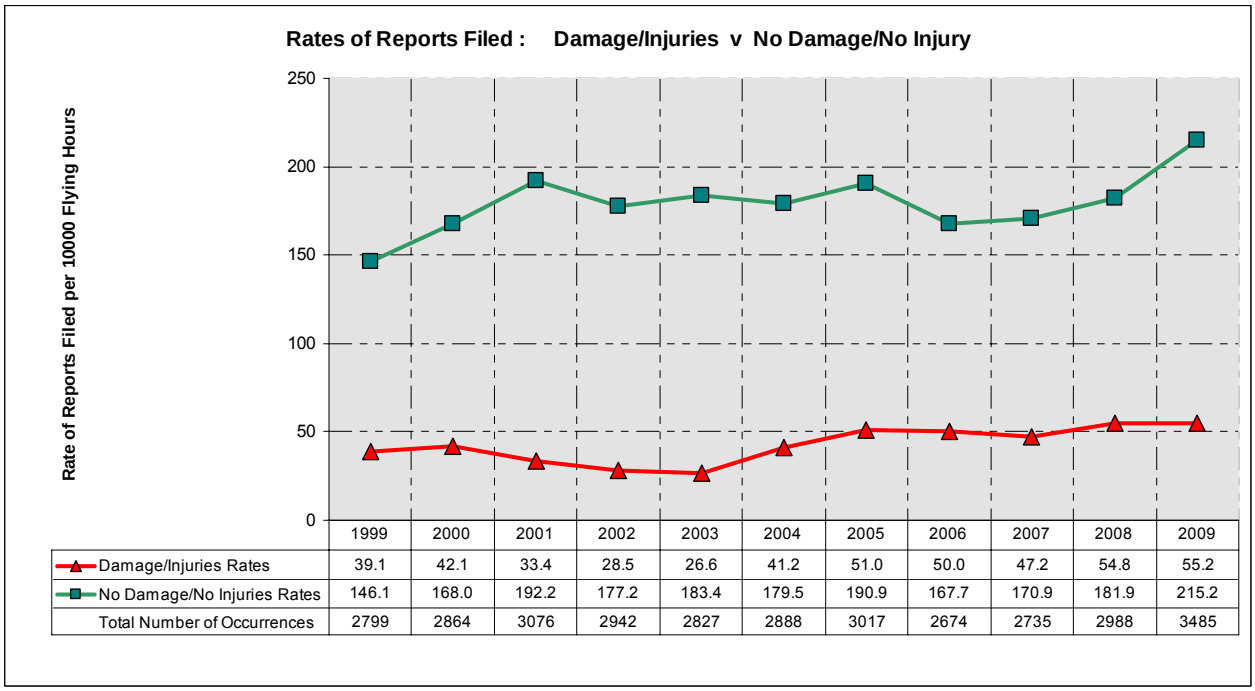
FLYING HOURS	99	00	01	02	03	04	05	06	07	08	09
FIGHTERS	**21709**	**19188**	**16967**	**17004**	**15126**	**13476**	**13836**	**13546**	**13142**	**13497**	**12980**
CF116	173	130	116	68	18	0	0	0	0	0	0
CF188	21536	19058	16851	16936	15108	13476	13836	13546	13142	13497	12980
HELICOPTERS	**44055**	**44068**	**43197**	**46725**	**44212**	**41317**	**38100**	**37270**	**38885**	**38406**	**36163**
CH113	6066	6306	5366	4040	1626	464	0	0	0	0	0
CH124	9068	9008	10576	10546	8226	8487	6857	6944	7628	7984	7567
CH139	5602	6121	6527	6666	6070	6371	5024	4613	4852	5684	1863
CH146	23319	22633	20489	22277	23384	21426	21632	21150	21465	19661	19698
CH147	0	0	0	0	0	0	0	0	0	4	2058
CH149	0	0	239	3196	4906	4568	4586	4563	4939	5073	4978
PATROL	**11619**	**10342**	**9418**	**10554**	**9684**	**9642**	**9324**	**8704**	**7012**	**5952**	**5323**
CP140	11619	10342	9418	10554	9684	9642	9324	8704	7012	5952	5323
TRAINERS	**31821**	**23466**	**29402**	**33085**	**35880**	**36533**	**33010**	**31981**	**36540**	**36151**	**36297**
CT102	0	0	0	0	0	0	0	2118	3805	4898	5817
CT111	4730	3879	4073	3230	2994	4163	3079	0	0	0	0
CT114	22983	12508	3477	4088	3894	3903	3757	4101	3912	3926	3861

FLYING HOURS	99	00	01	02	03	04	05	06	07	08	09
CT145	4108	4274	3708	3951	4771	5079	3271	2141	3381	3087	3425
CT146	0	0	0	0	0	0	38	93	67	980	2719
CT155	0	592	5128	7342	8383	8446	9137	8806	8714	6706	5836
CT156	0	2213	13016	14474	15838	14942	13728	14722	16661	16554	14639
TRANSPORT	**34964**	**33889**	**29964**	**31708**	**26879**	**27007**	**27599**	**27741**	**26319**	**28160**	**26972**
CC115	2492	2967	2316	2120	2439	1839	2533	2065	1762	1703	1599
CC130	21556	20716	17902	19308	14945	15839	15442	16486	14870	14359	12613
CC138	2550	2758	2455	1856	1923	1834	1962	1581	2166	2165	1830
CC142	1391	488	0	0	0	0	0	0	0	0	0
CC144	2821	2881	2963	3157	2812	2979	2815	2706	2445	2712	3095
CC150	4154	4079	4328	5267	4760	4516	4847	4903	4483	4666	4332
CC177	0	0	0	0	0	0	0	0	593	2556	3503
UAV	**0**	**0**	**0**	**0**	**55**	**117**	**141**	**876**	**1031**	**1994**	**6299**
CU161	0	0	0	0	55	117	141	876	1031	1725	883
CU170	0	0	0	0	0	0	0	0	0	269	5416
CF TOTAL	**144165**	**130954**	**128948**	**139074**	**131836**	**128090**	**122011**	**120116**	**122928**	**124160**	**124034**
GLIDERS	**17498**	**18049**	**16590**	**17634**	**16662**	**17068**	**16033**	**16149**	**15895**	**16050**	**15487**
GRAND TOTAL	**161663**	**149003**	**145538**	**156708**	**148497**	**145158**	**138044**	**136265**	**138823**	**140210**	**139521**

Table 4 – Flying Hours by Aircraft Family and Type

3.2.2 Reporting of Occurrences

A total of 3485 occurrences were reported (Graph 2). This represents an important increase from the 10-year mean value of 2881. The occurrence-reporting rate confirms this increase (270.4 compared to 10-year mean value of 217.2). The Damage/Injury –related occurrence rates has remained stable, while the others have increased. This is a straightforward indicator of an improvement in the reporting culture. The data indicated that 61% were Air occurrences and the remaining 39% were Ground occurrences. The increase was mainly seen in the following fleets; CF188, CH146, CH147, CT102, CT146 and CU170.



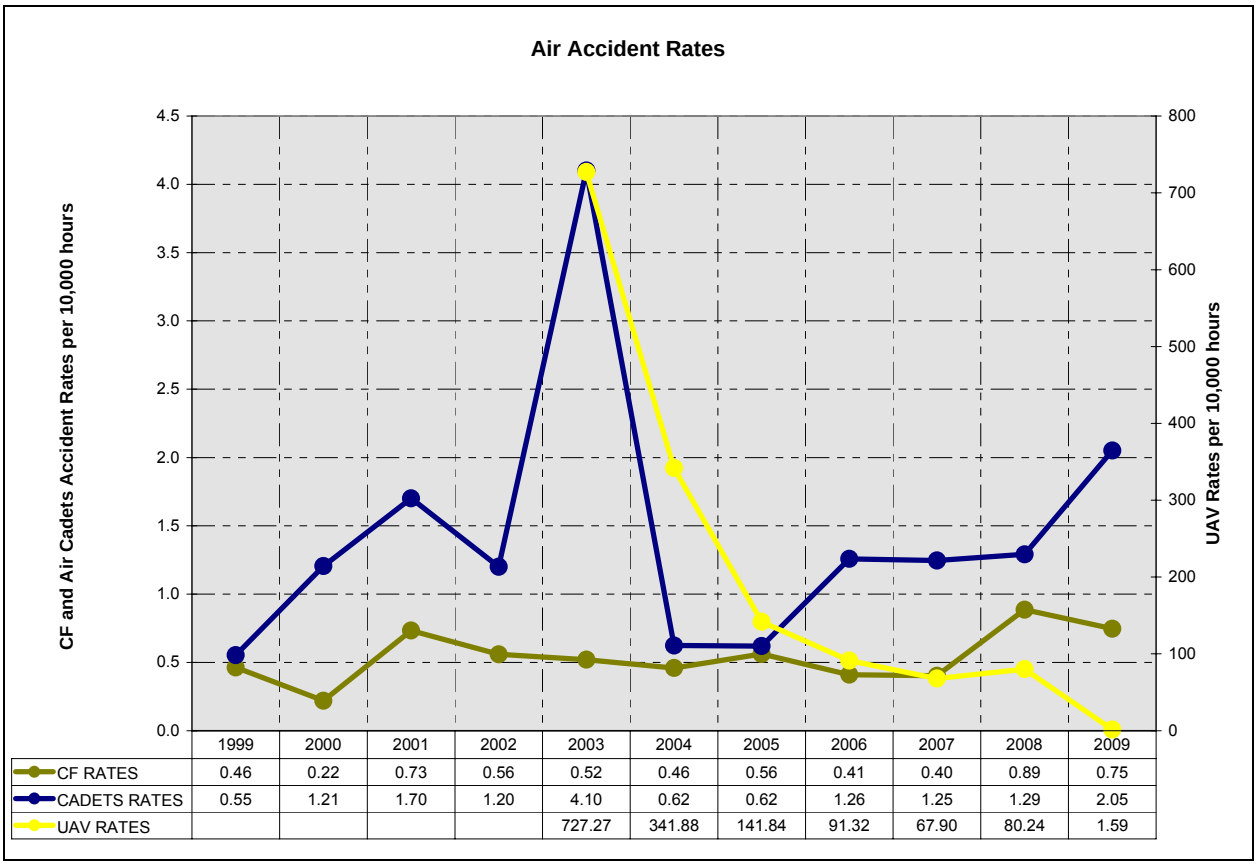
	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Damage/Injuries Rates	39.1	42.1	33.4	28.5	26.6	41.2	51.0	50.0	47.2	54.8	55.2
No Damage/No Injuries Rates	146.1	168.0	192.2	177.2	183.4	179.5	190.9	167.7	170.9	181.9	215.2
Total Number of Occurrences	2799	2864	3076	2942	2827	2888	3017	2674	2735	2988	3485

Graph 2 – Rates of Reports Filed Damage/Injury vs No Damage/No Injury

3.2.3 Accident Rate

3.2.3.1 Air Accident Rate

The overall CF Air Accident Rate less Cadets and UAVs has decreased compared to 2008 (0.75 vs 0.89), but is still higher than the 5-year mean (0.54). The breakdown of air accidents was 1 category 'A' accidents (CH146 Griffon), 1 category 'B' accident (CH147 Chinook) and 6 category 'C' accidents (2 CH146 Griffon, 2 CC130 Hercules, 1 CH149 Cormorant, 1 CF188 Hornet). The UAV air accident rate for 2009 was 1.59 (Graph 3). This is a significant decrease when compared with the 2008 rate (80.2) and the 5-year mean (Table 5). In 2009 the SPERWER was retired from service and the Heron was introduced, and is proving to be a much more airworthy platform. The Air Cadets represents a significant increase compared to 2008 (2.05 vs 1.29) and the previous 5-year mean (1.01) (Table 5). This value is based on three accidents; two involved misjudging an approach/landing, while the third occurred during the taxi phase. Studies were conducted by Defence Research and Development Canada (DRDC) Toronto and DFS Human Factors specialist on cadet accidents. DFS has asked D Cadets to consider some measures such as extending the length of the summer program and/or implementing a system of aptitude testing in order to mitigate the risks presented by youth and inexperience.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CF RATES	0.46	0.22	0.73	0.56	0.52	0.46	0.56	0.41	0.40	0.89	0.75
CADETS RATES	0.55	1.21	1.70	1.20	4.10	0.62	0.62	1.26	1.25	1.29	2.05
UAV RATES					727.27	341.88	141.84	91.32	67.90	80.24	1.59

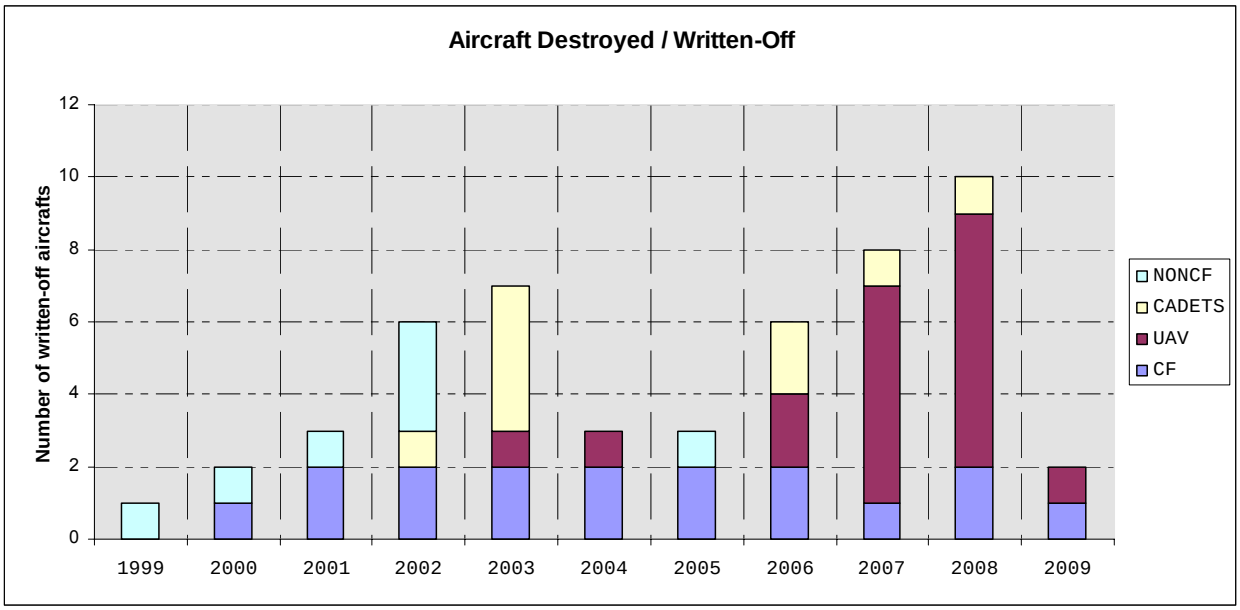
Graph 3 – Air Accident Rates

Air Accident Rates	08	04-08 Mean	04-08 SD	09	D
CF Rates (Excluding Cadets and UAVs)	0.89	0.54	0.20	0.75	1.01
Cadets Rates	1.29	1.01	0.35	2.05	2.96
UAV Rates	80.24	144.64	113.79	1.59	-1.26

Table 5 - Air Accident Rates

3.2.3.2 Aircraft Destroyed/Written-Off

Two aircraft were destroyed, both in a deployed theatre of operations (CU161 UAV Sperwer and a CH146 Griffon). Graph 4 provides an overall view for the last 10 years, while Table 6 sub-divides the numbers between Cadets, CF, UAVs and Non-CF. Although inferences cannot be made because of low numbers, the Destroyed/Write-Off rate appears to have significantly improved in 2009. The spikes in 2002-2003 and 2008 are attributable to Cadet and UAV accidents.



Graph 4 – Aircraft Destroyed / Written-Off

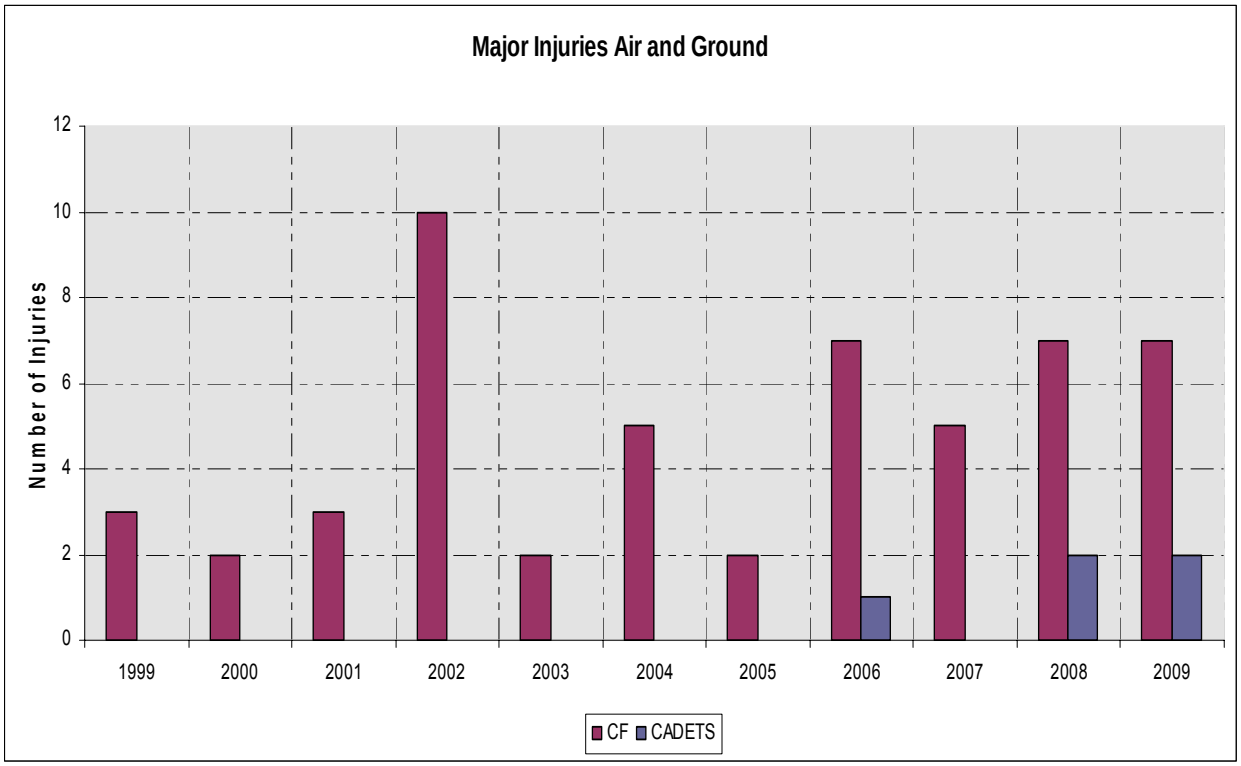
AIRCRAFT	99	00	01	02	03	04	05	06	07	08	99-08 Mean	99-08 SD	09	D
CF	0	1	2	2	2	2	2	2	1	2	1.6	0.7	1	-0.9
UAV	0	0	0	0	1	1	0	2	6	7	1.7	2.6	1	-0.3
CADETS	0	0	0	1	4	0	0	2	1	1	0.9	1.3	0	-0.7
NONCF	1	1	1	3	0	0	1	0	0	0	0.7	0.9	0	-0.7
Total	**1**	**2**	**3**	**6**	**7**	**3**	**3**	**6**	**8**	**10**	**4.9**	**2.9**	**2**	**-1.0**

Table 6 – Aircraft Destroyed / Written-off

3.2.4 Fatalities and Injuries

3.2.4.1 Major Injuries

There were 3 fatal and 1 serious injuries due to the CH146 accident in theatre. Additionally, 2 SAR Techs were injured in separate occurrences, one technician was seriously injured falling from a CH124 and 2 cadets suffered serious injury when a glider landed short of the intended runway.



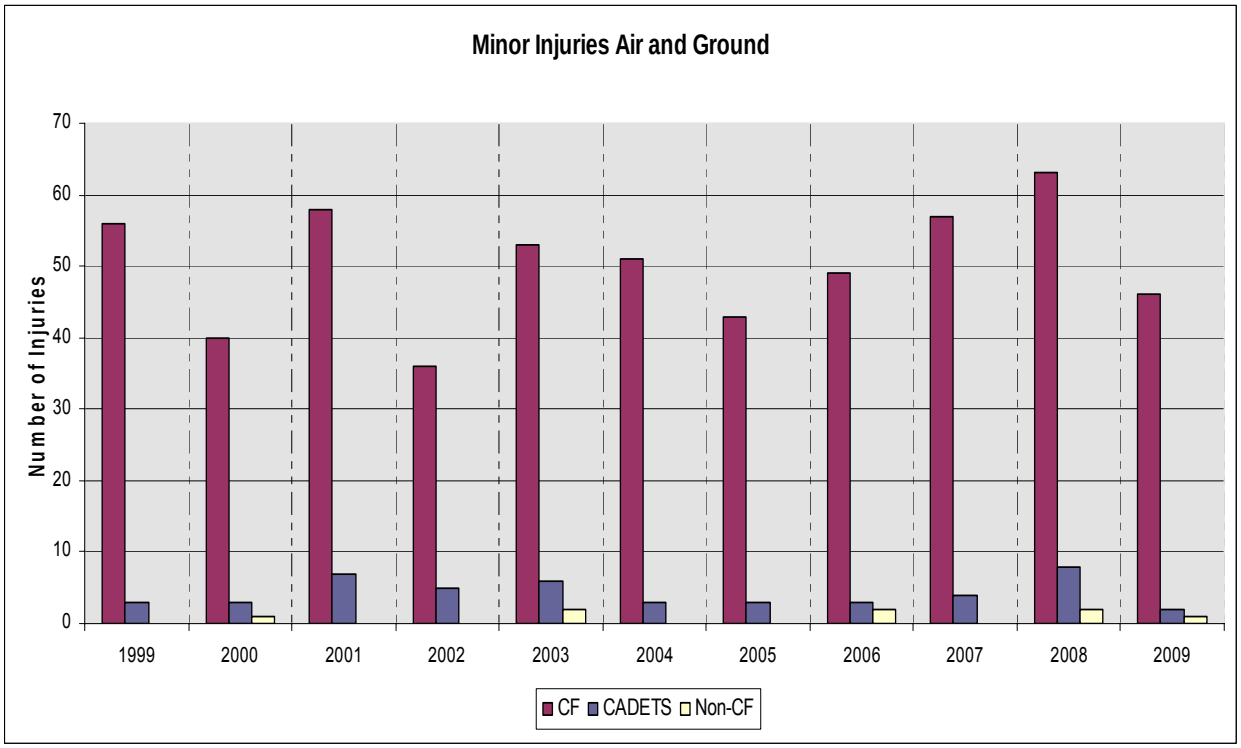
Graph 5 – Major Injuries

Year		99	00	01	02	03	04	05	06	07	08	09-08 Mean	09-08 SD	09	D
CF	Fatal	0	0	0	2	1	1	0	3	1	2	1.0	1.1	3	1.9
	Very Serious	0	0	1	1	0	0	0	0	1	2	0.5	0.7	0	-0.7
	Serious	3	2	2	7	1	4	2	4	3	3	3.1	1.7	4	0.5
	Total	**3**	**2**	**3**	**10**	**2**	**5**	**2**	**7**	**5**	**7**	**4.6**	**2.7**	**7**	**0.9**
CADETS	Very Serious	0	0	0	0	0	0	0	0	0	1	0.1	0.3	0	-0.3
	Serious	0	0	0	0	0	0	0	1	0	1	0.2	0.4	2	4.3
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**0.3**	**0.7**	**2**	2.5

Table 7 – Major Injuries

3.2.4.2 Minor Injuries

Graph 6 shows a total of 49 minor injuries occurred in 2009, down from 71 in 2008. This is a significant improvement over previous years.



Graph 6 - Minor Injuries

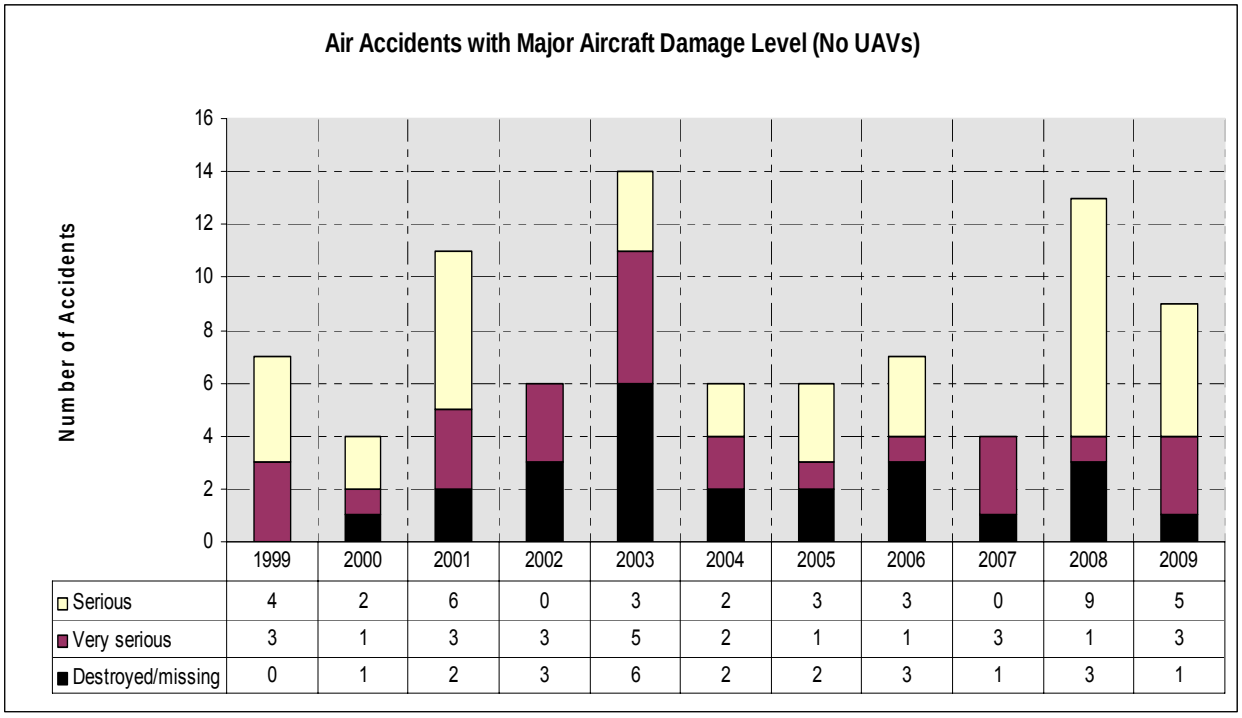
Year	99	00	01	02	03	04	05	06	07	08	Mean	SD	09	D
Cadets	3	3	7	5	6	3	3	3	4	8	4.5	1.9	2	-1.3
CF	56	40	58	36	53	51	43	49	57	63	50.6	8.6	46	-0.5
Non-CF	0	1	0	0	2	0	0	2	0	2	0.2	0.6	1	-0.3
Total	**59**	**44**	**65**	**41**	**61**	**54**	**46**	**54**	**61**	**73**	**55.8**	**10.0**	**49**	**-0.7**

Table 8 - Minor Injuries

3.2.5 Aircraft Damage Level (ADL)

3.2.5.1 Air Accidents by ADL

The number of occurrences with major ADL (excluding UAVs) has decreased, marking an overall improvement (Graph 7). For Air Cadets, the Serious and Very Serious ADL are shown as yellow, but does not represent a concern statistically.



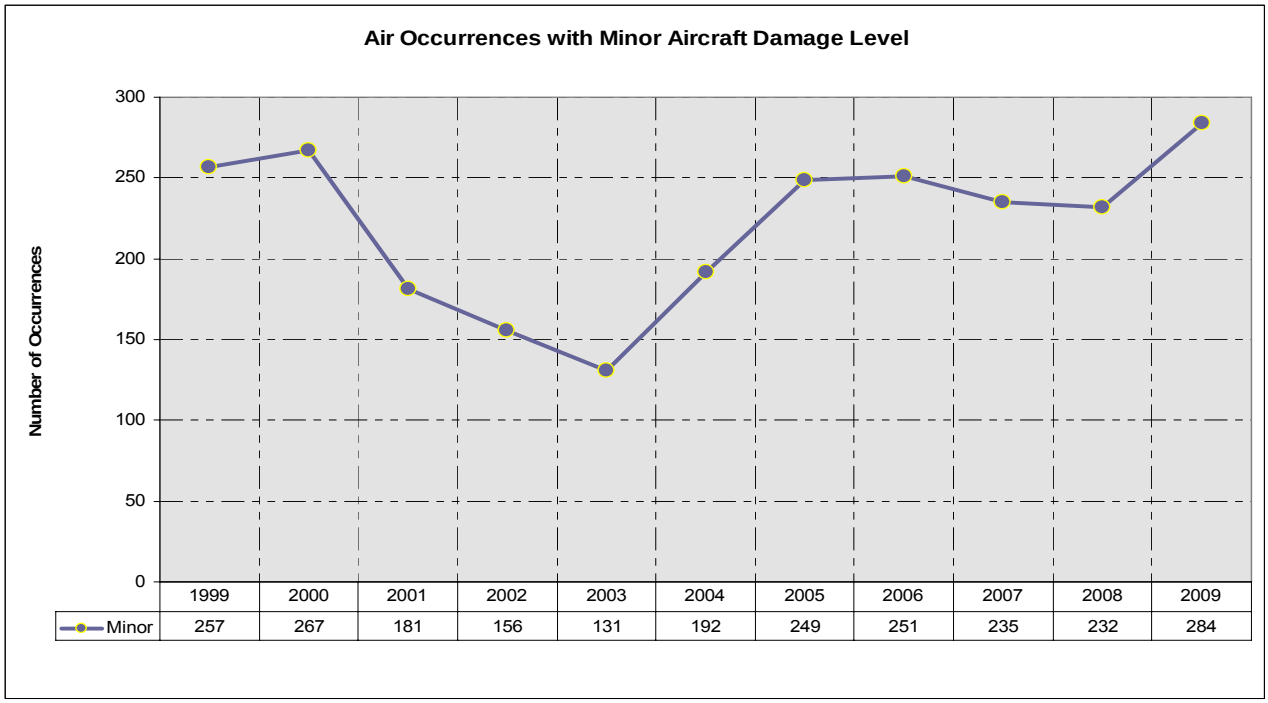
Graph 7 – Air Accidents by Major Aircraft Damage Level (No UAVs)

MAJOR ADL BY A/C TYPE		99	00	01	02	03	04	05	06	07	08	99-08 Mean	99-08 SD	09	D
CADETS	Destroyed	0	0	0	1	4	0	0	1	0	1	0.7	1.3	0	-0.6
	Very Serious	0	1	2	1	2	1	1	1	2	1	1.2	0.6	2	1.3
	Serious	1	1	1	0	1	0	0	0	0	0	0.4	0.5	1	1.2
	Total	**1**	**2**	**3**	**2**	**7**	**1**	**1**	**2**	**2**	**2**	**2.3**	**1.8**	**3**	0.4
CF	Destroyed	0	1	2	2	2	2	2	2	1	2	1.6	0.7	1	-0.9
	Very Serious	3	0	1	2	3	1	0	0	1	0	1.1	1.2	1	-0.1
	Serious	3	1	5	0	2	2	3	3	0	9	2.8	2.7	4	0.5
	Total	**6**	**2**	**8**	**4**	**7**	**5**	**5**	**5**	**2**	**11**	**5.5**	**2.7**	**6**	0.2
UAV	Destroyed	0	0	0	0	1	1	0	2	6	7	1.7	2.6	1	-0.3
	Very Serious	0	0	0	0	1	2	0	5	0	9	1.7	3.0	0	-0.6
	Serious	0	0	0	0	2	1	2	1	1	0	0.7	0.8	0	-0.9
	Total	**0**	**0**	**0**	**0**	**4**	**4**	**2**	**8**	**7**	**16**	**4.1**	**5.1**	**1**	**-0.6**
Total		**7**	**4**	**11**	**6**	**18**	**10**	**8**	**15**	**11**	**29**	**11.9**	**7.3**	**10**	**-0.3**

Table 9– Air Accidents Sorted by Aircraft Type and Major ADL

3.2.5.2 Air Occurrences with Minor ADL

Notwithstanding the reduction in air accidents, there has been a significant increase in occurrences with minor ADL (Graph 8). The 2009 values fall just outside the normal variation, and should be closely monitored in future years.



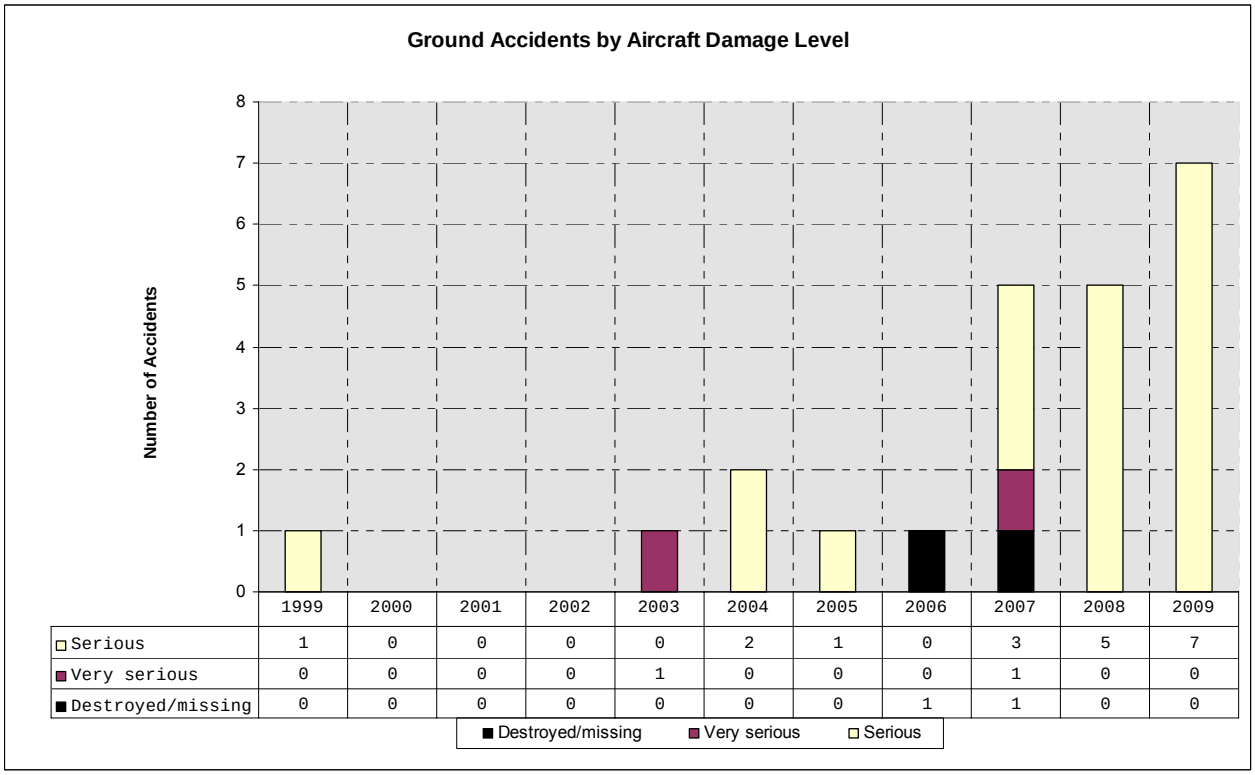
Graph 8 – Air Occurrences with Minor Aircraft Damage Level

AIR OCCURRENCES WITH MINOR ADL	99	00	01	02	03	04	05	06	07	08	99-08 Mean	99-08 SD	09	D
CADETS	8	12	10	20	11	8	10	19	11	19	12.8	4.7	17	0.9
CF	249	255	171	136	118	181	236	209	216	205	197.6	46.0	258	1.3
UAV	0	0	0	0	2	3	3	23	8	8	7.8	7.9	9	0.1
Total	**257**	**267**	**181**	**156**	**131**	**192**	**249**	**251**	**235**	**232**	**215.1**	**46.9**	**284**	**1.5**

Table 10 – Air Occurrences with Minor ADL by Aircraft Types

3.2.5.3 Ground Accidents by ADL

Overall, the number of ground occurrences with major ADL has increased again in 2009 (Graph 9 and Table 11). The number of serious ground accidents represents a significant increase from the 10-year mean, but is not attributable to any particular fleet. The 7 ground accidents in 2009 were comprised of 3 CF188, a CC115, a CH146, a CH149, and a CU170. Ground accidents were similarly spread across the air force fleets in previous years.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Serious	1	0	0	0	0	2	1	0	3	5	7
Very serious	0	0	0	0	1	0	0	0	1	0	0
Destroyed/missing	0	0	0	0	0	0	0	1	1	0	0

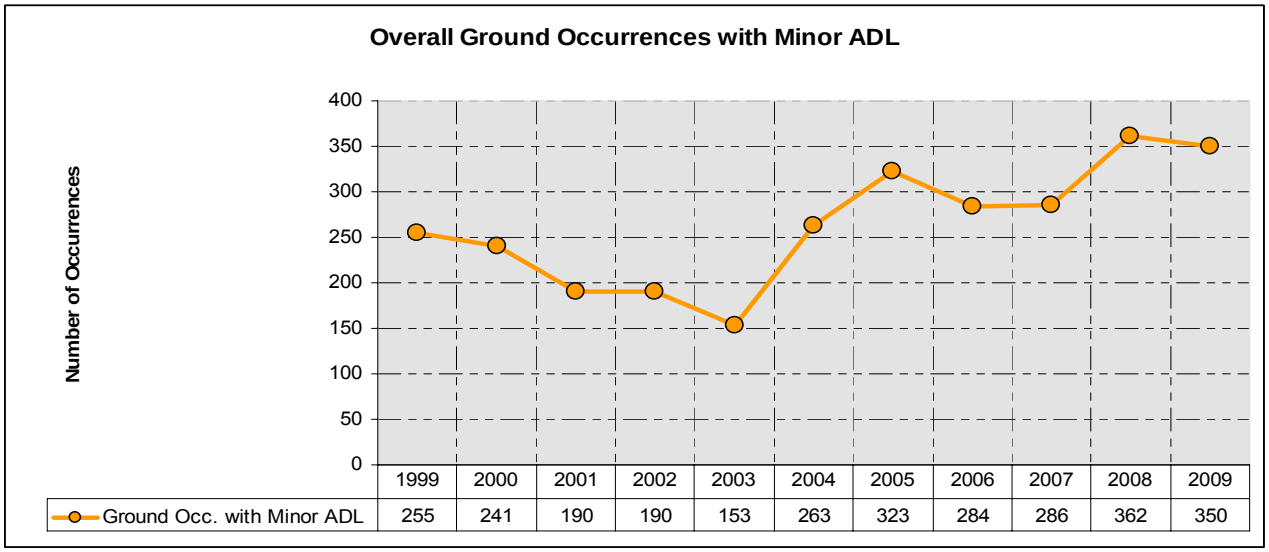
Graph 9 – Ground Accidents by Aircraft Damage Level

GROUND ACCIDENTS WITH MAJOR ADL BY A/C TYPE		99	00	01	02	03	04	05	06	07	08	99-08 Mean	99-08 SD	09	D
CADETS	Destroyed	0	0	0	0	0	0	0	1	1	0	0.2	0.4	0	-0.5
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0.2**	**0.4**	**0**	**-0.5**
CF	Very Serious	0	0	0	0	1	0	0	0	0	0	0.1	0.3	0	-0.3
	Serious	1	0	0	0	0	2	1	0	3	5	1.2	1.7	6	2.8
	Total	**1**	**0**	**0**	**0**	**1**	**2**	**1**	**0**	**3**	**5**	**1.3**	**1.6**	**6**	**2.9**
UAV	Very Serious	0	0	0	0	0	0	0	0	1	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	0	0	0	0	0	0	0	0.0	1	0.0
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0.1**	**0.3**	**1**	**2.8**
Total		**1**	**0**	**0**	**0**	**1**	**2**	**1**	**1**	**5**	**5**	**1.6**	**1.9**	**5**	**2.8**

Table 11 – Ground Accidents Sorted by type and Major ADL

3.2.5.4 Ground Occurrences with Minor ADL

The minor ADL Ground Occurrences (Graph 10 and Table 12) have decreased from the previous year, but are still considerably above the mean.



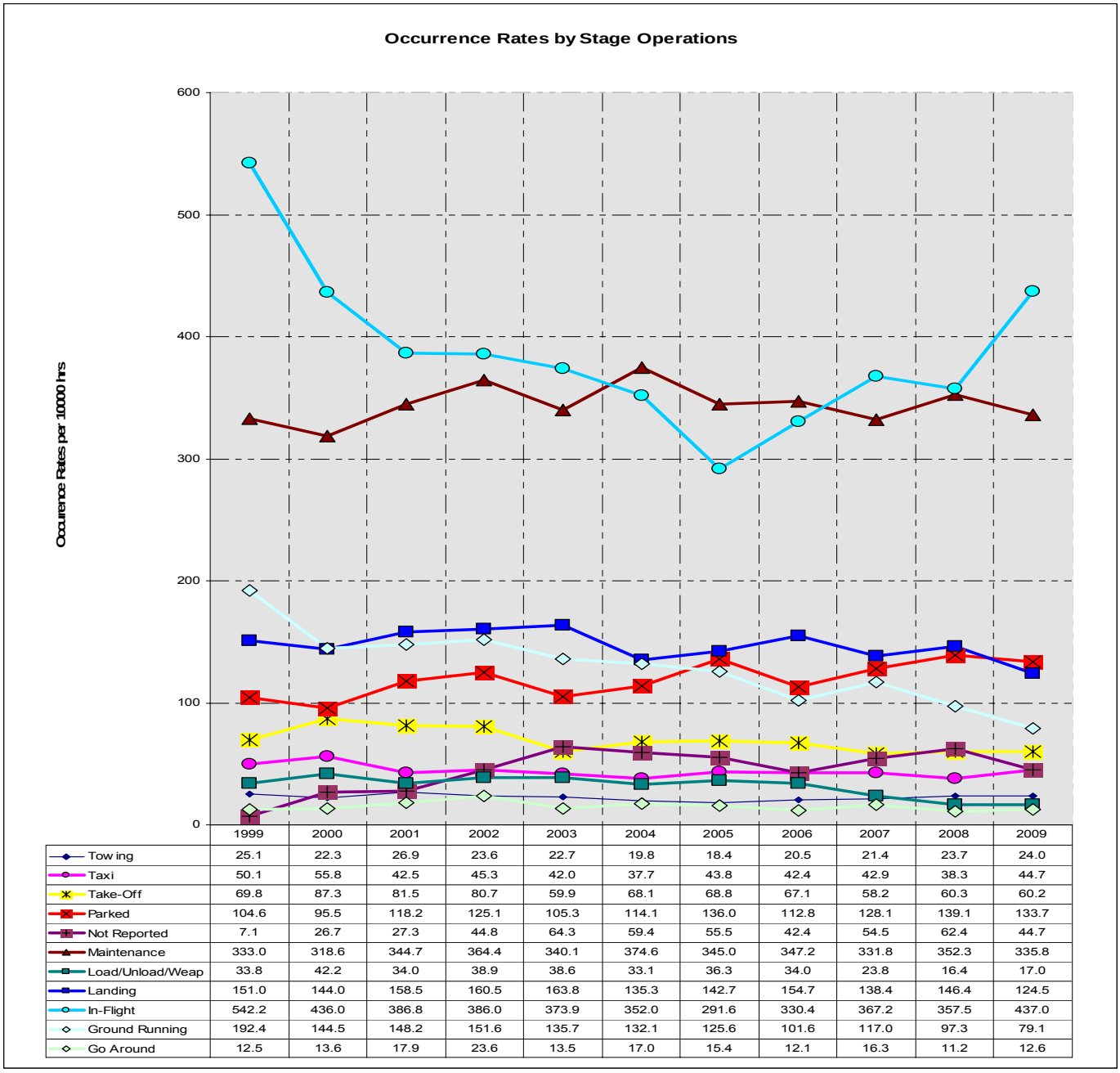
Graph 10 – Ground Occurrences with Minor Aircraft Damage Level

GROUND OCCURRENCE WITH MINOR ADL BY A/C TYPE	99	00	01	02	03	04	05	06	07	08	99-08 Mean	99-08 SD	09	D
CADETS	13	5	6	14	10	5	13	8	15	22	11.1	5.4	15	0.7
CF	242	236	184	176	141	257	309	276	269	340	243	61.6	334	1.5
UAV	0	0	0	0	2	1	1	0	2	0	0.6	0.8	1	0.5
Total	**255**	**241**	**190**	**190**	**153**	**263**	**323**	**284**	**286**	**362**	**254.7**	**64.1**	**350**	**1.5**

Table 12 – Ground Occurrences with Minor ADL by A/C Type

3.2.5.5 Occurrences by Stage of Operations

The only Stage of Operations that has shown a marked increase is the In-Flight stage (Graph 11). With a D value of 0.8, this is within the normal variation and does not represent a significant concern.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Tow ing	25.1	22.3	26.9	23.6	22.7	19.8	18.4	20.5	21.4	23.7	24.0
Taxi	50.1	55.8	42.5	45.3	42.0	37.7	43.8	42.4	42.9	38.3	44.7
Take-Off	69.8	87.3	81.5	80.7	59.9	68.1	68.8	67.1	58.2	60.3	60.2
Parked	104.6	95.5	118.2	125.1	105.3	114.1	136.0	112.8	128.1	139.1	133.7
Not Reported	7.1	26.7	27.3	44.8	64.3	59.4	55.5	42.4	54.5	62.4	44.7
Maintenance	333.0	318.6	344.7	364.4	340.1	374.6	345.0	347.2	331.8	352.3	335.8
Load/Unload/Weap	33.8	42.2	34.0	38.9	38.6	33.1	36.3	34.0	23.8	16.4	17.0
Landing	151.0	144.0	158.5	160.5	163.8	135.3	142.7	154.7	138.4	146.4	124.5
In-Flight	542.2	436.0	386.8	386.0	373.9	352.0	291.6	330.4	367.2	357.5	437.0
Ground Running	192.4	144.5	148.2	151.6	135.7	132.1	125.6	101.6	117.0	97.3	79.1
Go Around	12.5	13.6	17.9	23.6	13.5	17.0	15.4	12.1	16.3	11.2	12.6

Graph 11 – Occurrence Rates by Stage of Operation - Air and Ground

OCCURRENCE RATES BY STAGE OF OPERATION	08	99-08 Mean	99-08 SD	09	D
Towing	23.7	22.4	2.5	24.0	0.6
Taxi	38.3	44.1	5.4	44.7	0.1
Take-Off	60.3	70.2	10.0	60.2	-1.0
Parked	139.1	117.9	14.2	133.7	1.1
Not Reported	62.4	44.4	18.8	44.7	0.0
Maintenance	352.3	345.2	16.1	335.8	-0.6
Load/Unload/W. Handling	16.4	33.1	7.6	17.0	-2.1
Landing	146.4	149.5	9.7	124.5	-2.6
In-Flight	357.5	382.4	67.7	437.0	0.8
Ground Running	97.3	134.6	27.5	79.1	-2.0
Go Around	11.2	15.3	3.7	12.6	-0.8
Total	**1304.9**	**1359.1**	**79.7**	**1313.3**	**-0.6**

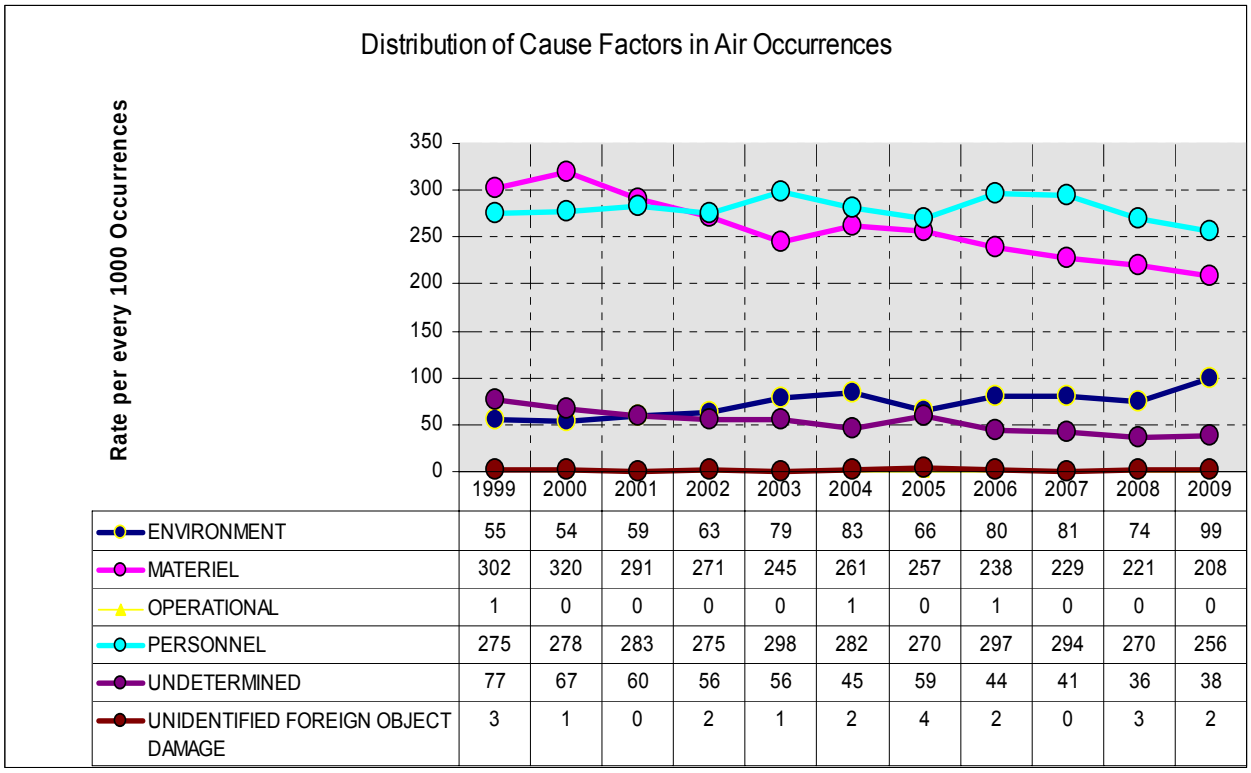
Table 13 - Occurrence Rates by Stage of Operation

3.3 CAUSE FACTORS

3.3.1 Cause Factor Breakdown Analysis

3.3.1.1 Air Occurrences

There has been no significant change in the distribution of cause factors in air occurrences as seen in Graph 12.



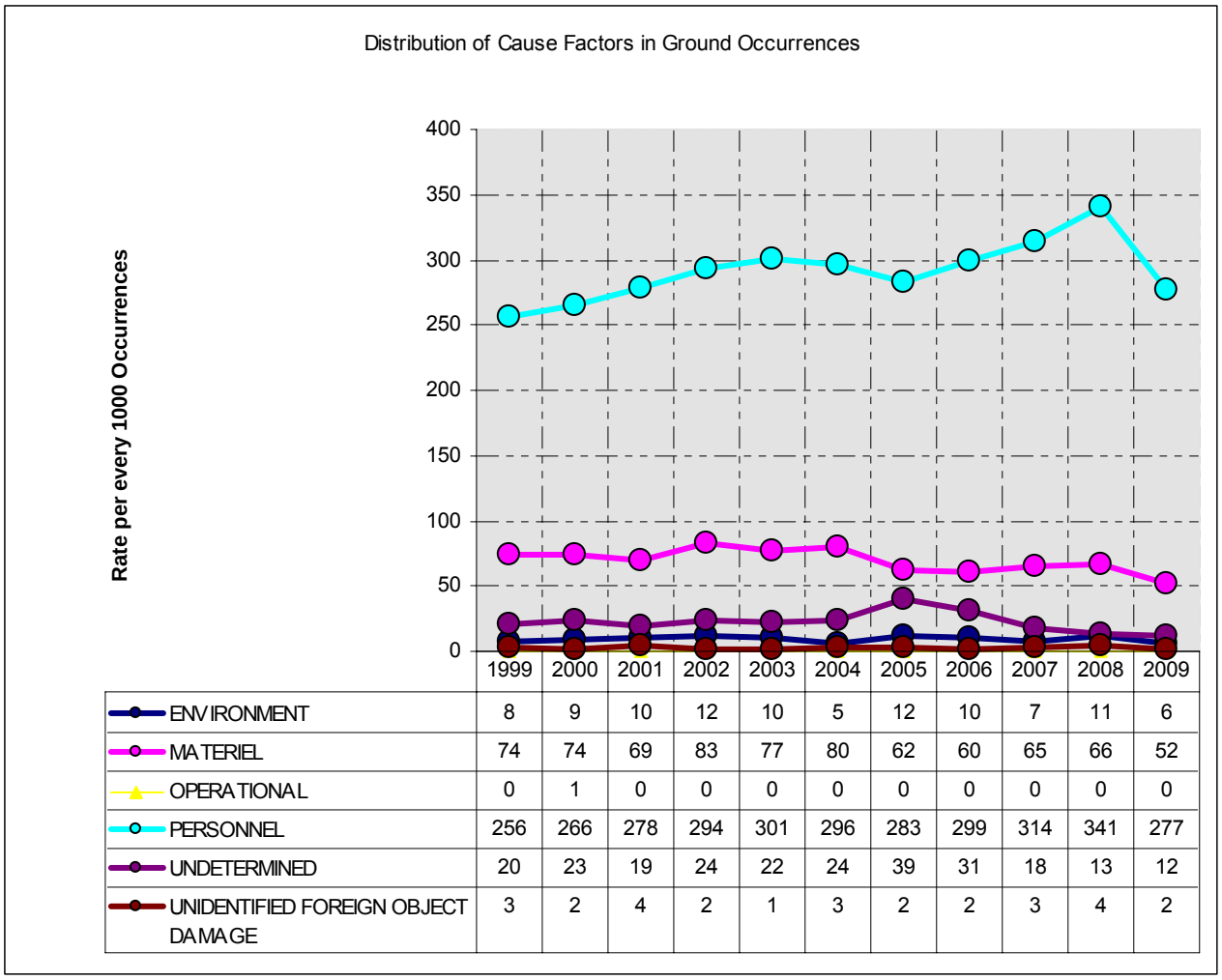
Graph 12 - Distribution of Cause Factors in Air Occurrences

Air Cause Factors by Type	2008	99-08 Mean	99-08 SD	2009	D
Environment	34	27.4	7.2	21	-0.9
Materiel	197	204.9	24.8	182	-0.9
Operational	0	0.2	0.6	1	1.3
Personnel	1019	843.5	79.5	967	1.6
Undetermined	39	67.2	21.6	43	-1.1
Unidentified FOD	13	7.5	3.2	6	-0.5
Total	**1302**	**1150.7**	**84.8**	**1220**	**0.8**

Table 14 - Air Cause Factors by Type

3.3.1.2 Ground Occurrences

There has been no significant change in the distribution of cause factors in ground occurrences as seen in Graph 13.



	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
ENVIRONMENT	8	9	10	12	10	5	12	10	7	11	6
MATERIEL	74	74	69	83	77	80	62	60	65	66	52
OPERATIONAL	0	1	0	0	0	0	0	0	0	0	0
PERSONNEL	256	266	278	294	301	296	283	299	314	341	277
UNDETERMINED	20	23	19	24	22	24	39	31	18	13	12
UNIDENTIFIED FOREIGN OBJECT DAMAGE	3	2	4	2	1	3	2	2	3	4	2

Graph 13 - Distribution of Cause Factors in Ground Occurrences

Ground Cause Factors by Type	2008	99-08 Mean	99-08 SD	09	D
Environment	11	9.5	2.3	6	-1.5
Materiel	66	71.1	7.8	52	-2.4
Operational	0	0.1	0.2	0	1.0
Personnel	341	292.8	24.4	277	-0.6
Undetermined	13	23.3	7.3	12	-1.5
Unidentified FOD	4	2.6	1.0	2	-0.8
Total	**436**	**399.3**	**21.9**	**350**	**-2.2**

Table 15 - Ground Cause Factors by Type

3.3.1.3 Comparison of Cause Factors for Air and Ground Occurrences

There is a marked difference in cause factor attribution for air and ground occurrences, most notably for 'Personnel' as a cause factor; 79.2% of ground occurrences involve a personnel cause factor, compared to only 42.4% of air occurrences. This can be attributable to the differences between Air and Ground operations. Air operations rely primarily on an abundance of highly technical inter-related systems, whereas ground operations employ independent systems less likely to directly affect safety of flight.

3.3.2 HFACS Analysis

The methodology to analyze HFACS data is still evolving. The Cause Factors that represent a significant statistical trend are Ground Perception errors and Air Supervision errors. Although 4 fleets are mainly responsible for the increase (CC130, CF188, CH146 and CP 140) in ground perception errors, an in depth analysis of each occurrence would be required to correlate any trend information. The increase in Air Supervision errors was mainly attributable to 5 different fleets (CH146, CT146, CH139, CT102 and SZ23). The assigned causes included Improper Risk Assessment as well as Planning Beyond Ability /Capability of Personnel. It should also be noted that data is limited and highly random for the Air Supervision occurrences, hence less reliable. Further, as part of the review of occurrences attributed to Deviations done in Fall 09, it was discovered that the assignment of Human Cause factors by different FS Officers varies greatly. The issue of quality control needs to be addressed before a systemic analysis of these cause factors can lead to definite findings.

CAUSE FACTORS		TYPE	CAUSE FACTORS vs REPORTS FILED (#Occurrences per Factor/ #Reports Filed) * 1000			
			Mean 04-08	08	09 Value and Concern Level	Randomness Level 04-09
ACTIVE FAILURES						
ERRORS	**Decision Error**	**Air**	79.7	78	76	Medium
		Ground	83	91	71	Medium
	Perception Error	**Air**	24.6	31	45	Very Low
		Ground	15.3	22	36	Very Low
	Skilled Based Error	**Air**	213.2	196	184	Very Low
		Ground	210.7	231	195	Very Low
DEVIATIONS	**Routine Deviation**	**Air**	3.6	3	5	Medium
		Ground	8.3	8	9	Very Low
	Exceptional Deviation	**Air**	11.7	5	8	Low
		Ground	30.9	24	18	Medium
LATENT CONDITIONS						
CONDITIONS OF PERSONNEL	**Mental State**	**Air**	156.3	169	172	Very Low
		Ground	143.2	205	173	Very Low
	Physical / Mental Capabilities	**Air**	26.9	27	28	Very Low
		Ground	23.2	33	22	Very Low

CAUSE FACTORS		TYPE	CAUSE FACTORS vs REPORTS FILED (#Occurrences per Factor/ #Reports Filed) * 1000			
			Mean 04-08	08	09 Value and Concern Level	Randomness Level 04-09
	Physiological States	Air	3.0	2	2	n/a
		Ground	1.7	2	1	n/a
WORKING CONDITIONS	Technological Environment	Air	11.4	14	14	Very Low
		Ground	13.9	16	11	Medium
	Physical Environment	Air	16.1	23	24	Very Low
		Ground	15.6	23	25	Very Low
PRACTICES OF PERSONNEL	Resource Management	Air	35.9	45	43	Low
		Ground	32.4	50	40	Medium
	Personal Readiness	Air	0.9	2	1	n/a
		Ground	0.4	0	1	n/a
SUPERVISION	Planned Activities	Air	7.4	7	12	High
		Ground	13.9	16	14	Low
	Problem Correction	Air	4.7	4	5	Medium
		Ground	8.7	13	12	Low
	Supervisory Deviation	Air	0.8	1	3	n/a
		Ground	3.7	6	5	High
	Level of Supervision	Air	29.6	27	26	Very Low
		Ground	52.2	61	59	High
ORG INFLUENCES	Organizational Climate	Air	4.9	5	7	High
		Ground	8.9	12	10	Low
	Organizational Process	Air	15.8	13	9	Low
		Ground	26.1	25	18	Medium
	Resource Management	Air	35.9	45	43	High
		Ground	32.4	50	40	Medium

Table 16 - Air & Ground Occurrences - HFACS Cause Factor Percentage Breakdown

3.3.2.1 Routine vs Exceptional Deviations

Any Deviation is cause for concern, as it implies a wilful intent to disregard orders and/or approved procedures. In particular, Exceptional Deviations call for the chain of command to examine the FS culture within the unit and adopt positive measures to neutralize any deficient attitude to the good conduct of air operations. DFS in conjunction with 1 Cdn Air Div FS staff are reviewing these deviations to determine if the initial findings are valid and what recommendations could be made to the chain of command to help reduce the Exceptional Deviations.

Although a decreasing trend has been noted in the percentages of reported Deviations (Table 16), the Exceptional Deviations far outnumbers Routine Deviation, when the reverse is considered the norm. In trying to determine the cause(s) of the high number of Exceptional Deviations, DFS has discovered issues with how the events are interpreted / categorized by FS staff. In order to address this problem, a review of the Basic Flight Safety Course Qualification Standard has been done and the A-GA-135-001/AA-001 has been amended. DFS and 1 Cdn Air Div FS staff are assessing additional options to improve HFACS investigations.

DEVIATIONS	04	05	06	07	08	99-08 Mean	99-08 SD	09	D
Routine	51	33	33	21	33	34.2	10.7	46	1.1
Exceptional	122	121	138	136	88	121	20.0	91	-1.5
%Deviation in Relation to All Occurrences	6.1%	5.6%	6.5%	5.8%	4.1%	5.5%	0.9%	4.0%	-1.7

Table 17 - Routine vs Exception Deviations

3.3.3 System Descriptors

Aircraft system descriptors were compared to their respective means in order to determine the top three systems on each aircraft that could be of concern (Table 18). These rates were also analysed in relation to the RL to determine the relative validity of the information. A low RL value suggests a systematic pattern and is a good indication of a trend. Where Table 17 indicates an area of concern (Orange or Maroon), further information is provided in follow-on sub-paragraphs. As applicable, key inputs submitted by DFS to the Airworthiness Review Board are provided.

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		MEAN 99-08	08	09	RL 00-09
ALL A/C	**N/A**	**199.0**	**202.0**	**212.6**	**Low**
CC115 Buffalo	**Overall**	**261.7**	**458.1**	**519.0**	**Very low**
	Weapons systems	36.2	76.4	125.1	High
	Survival & safety equipment	38.2	35.2	56.3	Very low
	Undercarriage (landing gear)	26.4	35.2	50.0	High

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		MEAN 99-08	08	09	RL 00-09
CC130 Hercules	**Overall**	**226.7**	**309.2**	**310.0**	**Medium**
	Other	8.2	34.8	39.6	Very low
	Weapons Systems	12.4	27.9	34.9	Medium
	Propeller	15.6	19.5	28.5	High
CC138 Twin Otter	**Overall**	**73.5**	**37.0**	**92.9**	**Very Low**
	Fuel Systems	5.8	0.0	32.8	n/a
	Undercarriage (landing gear)	8.6	9.2	21.9	n/a
	Electrical Systems	10.0	4.6	16.4	n/a
CC144 Challenger	**Overall**	**40.4**	**29.5**	**16.2**	**Low**
	Controls (Other)	0.3	0.0	3.2	n/a
	Elevators and Stabilator	1.1	3.7	3.2	n/a
	Flaps	1.5	11.1	3.2	n/a
CC150 Polaris (Airbus 310)	**Overall**	**47.8**	**15.0**	**9.2**	**Medium**
	Controls (Other)	0.8	0.0	2.3	n/a
	Fuel Systems	2.3	2.1	2.3	n/a
	Jet/Turbo Basic Engine	1.4	0.0	2.3	n/a
CC177 Globemaster III	**Overall**	**43.7**	**70.4**	**17.1**	**n/a**
	Panels / Doors / Transparent Areas	7.8	15.7	5.7	n/a
	Electrical Systems	0.0	0.0	2.9	n/a
	Other	2.0	3.9	2.9	n/a
CF188 Hornet	**Overall**	**340.9**	**323.0**	**428.4**	**High**
	Weapons Systems	61.6	68.2	90.1	High
	Undercarriage (Landing Gear)	42.6	48.9	49.3	Medium
	Survival & Safety Equipment	27.8	34.8	43.1	High
CH124 Sea King	**Overall**	**198.2**	**175.4**	**143.0**	**Very low**
	Weapons Systems	13.2	26.3	16.0	Very low
	Other	11.1	6.3	14.0	High
	Electrical systems	14.1	12.5	11.0	High
CH139 Jet Ranger Bell 206B	**Overall**	**24.0**	**40.5**	**187.9**	**High**
	Helicopter Flight Controls	2.4	8.8	96.6	n/a
	Helo Main Rotor Head / Rotor Drive Train	1.2	3.5	21.5	n/a
	Gearboxes/Accessories/ Drives	1.2	1.8	10.7	n/a

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		MEAN 99-08	08	09	RL 00-09
CH146 Griffon	**Overall**	**139.4**	**119.5**	**108.6**	**High**
	Helicopter Flight Controls	21.7	18.8	16.8	Medium
	Panels / Doors / Transparent Areas	9.8	9.2	13.7	Medium
	Weapons systems	1.9	4.6	11.7	Medium
CH149 Cormorant	**Overall**	**156.0**	**250.3**	**251.1**	**Very low**
	Furnishings and Loose Equipment	25.4	47.3	50.2	High
	Survival & Safety Equipment	9.1	17.7	32.1	High
	Helicopter Flight Controls	31.8	55.2	26.1	Medium
CP140 Aurora	**Overall**	**239.1**	**277.2**	**231.1**	**Low**
	Electrical Systems	23.2	38.6	30.1	Medium
	Other	13.1	15.1	24.4	High
	Undercarriage (Landing Gear)	16.7	20.2	20.7	High
CT102 Astra	**Overall**	**49.7**	**34.7**	**113.5**	**Very Low**
	Other	1.4	4.1	27.5	n/a
	Undercarriage (Landing Gear)	8.8	16.3	20.6	n/a
	Fuselage / Wings / Empennage	8.2	2.0	12.0	n/a
CT114 Tutor	**Overall**	**128.7**	**150.3**	**145.0**	**Low**
	Fuselage / Wings / Empennage	18.7	15.3	25.9	Low
	Fuel Systems	8.4	5.1	20.7	High
	Survival & Safety Equipment	12.9	33.1	15.5	High
CT142 Dash-8	**Overall**	**93.9**	**116.6**	**145.0**	**Very Low**
	Undercarriage (Landing Gear)	9.8	19.4	25.9	n/a
	Fuel Systems	3.7	0.0	15.5	n/a
	Hydraulics	4.9	4.9	15.5	n/a
CT145 King Air	**Overall**	**28.9**	**61.5**	**78.8**	**Very Low**
	Flight Instruments	0.8	0.0	14.6	n/a
	Undercarriage (Landing Gear)	7.7	9.7	14.6	n/a
	Other	1.5	9.7	8.8	n/a
CT155 Hawk	**Overall**	**128.9**	**126.7**	**85.0**	**Very low**
	Undercarriage (Landing Gear)	28.1	31.3	21.0	Very low
	Panels / Doors / Transparent Areas	11.9	8.9	11.0	Medium
	Fuselage / Wings / Empennage	26.0	22.4	10.0	High

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		MEAN 99-08	08	09	RL 00-09
CT156 Harvard II	**Overall**	**93.7**	**95.4**	**80.6**	**Very low**
	Undercarriage (Landing Gear)	31.6	30.2	27.3	Low
	Survival & Safety Equipment	11.0	10.3	8.2	High
	Flaps	7.9	8.5	6.1	Medium

Table 18 - System Descriptor by Fleet (The colour code is based on the D value)

3.3.3.1 Fleet Concerns

- CC115. Flares and pyrotechnics malfunctions contributed to the significant increase in Weapons System occurrences over previous years. There are no other specific flight safety concerns at this time.

- CC130. The CC130 Hercules is an aging fleet with 14 Open/Active RARMs. Propeller Low Oil Light indications will continue to be a concern with the legacy CC130 fleet until a proper redesign of the system can be implemented.

- CC138. There were 5 mixed fuel system occurrences which represents a significant increase for this descriptor. Examples include unsecure fuel caps and a contaminated fuel hose. A total of 4 undercarriage problems, primarily broken ski brackets and cables, also represented an increase over previous years. The low number of occurrences makes it difficult to determine if there is a trend, but this issue should be monitored in future years. There are no other specific flight safety concerns at this time.

- CC144. There are no specific flight safety concerns at this time.

- CC150. There are no specific flight safety concerns at this time.

- CC177. There are no specific flight safety concerns at this time.

- CF188. There were 55 survival & safety systems occurrences including unconnected lanyards to open seat packs, and incorrectly installed ejection initiators. Although this is a slight increase over last year, this system descriptor is traditionally very random, and does not necessarily represent a trend.

- CH124. There are no specific flight safety concerns at this time.

- CH139. There has been a significant increase in reporting for the CH139, despite reduced flying hours. Periodic monitoring of Data Acquisition Units for exceedences may account for part of the improvement.

- CH146. There were 24 occurrences involving Weapons System issues including incorrect type of flares installed, M134 Dillon gun damage, and spent shell casings found

in the Rotor Gear Box compartment. This is a significant increase in occurrences for this system descriptor that is a result of increased door gun employment both operationally and in training. There are concerns about the stresses the CH146 is subjected to in deployed operations. RARMs have been published to mitigate the risks.

- CH149. Survival & Safety occurrences experienced a significant increase, based on 16 occurrences including expired floatation bottles, partially inflated life rafts, and unserviceable SAR Tech harnesses. The high randomness of this category makes it difficult to determine if there is a trend, but it may be an indicator and should be monitored in the future. The new Flight Safety concerns for this period are communication system issues (7 occurrences), main gear box cracking, cockpit or cabin fumes (15 occurrences) and ongoing hoist issues (32 occurrences). Staffs in all organisations are monitoring known issues with the Cormorant such as hoist stoppages, FDR data drop outs, CVR recording levels, corrosion, main gear box cracking and Tail Rotor Half Hub (TRHH) cracking.

- CP140. The increase in Other Systems occurrences consisted mostly of smoke and fumes in the cabin. A review of the occurrences did not yield a common denominator; however, there were a few unexplained occurrences which may be due to aging wiring. The Weapon System Manager will continue to monitor this issue.

- CT114. Miscellaneous fuel problems, including low fuel pressure, a fuel leak, and cracked fuel gauges represented the 8 fuel issues. Although this is a significant increase from previous years, it is highly random. There are no other specific safety concerns at this time.

- CT142. There were 3 miscellaneous hydraulics problems, and 2 fuel systems problems that represented increases from previous years. Because of their low numbers, they are not statistically significant. There are no other specific safety concerns at this time.

- CT155. Bird strikes continue to be one of the primary safety concerns for this fleet as it still does a significant amount of its flight in the low-level environment. The previous issue of the turbine blade root failures and blade tracking appears to have been mitigated and no new failures have been observed since Feb 09.

- CT156. A RARM is still in place for propeller shaft touchdowns with medium risk. Action is being taken through a service bulletin and a modification which should allow this RARM to be closed sometime after 31 Jul 10. The process for implementing a technical solution to the near misses is taking significant time, due to delays in completing necessary studies and cost estimates. A RARM is in place to mitigate the risk for stuck rudders.

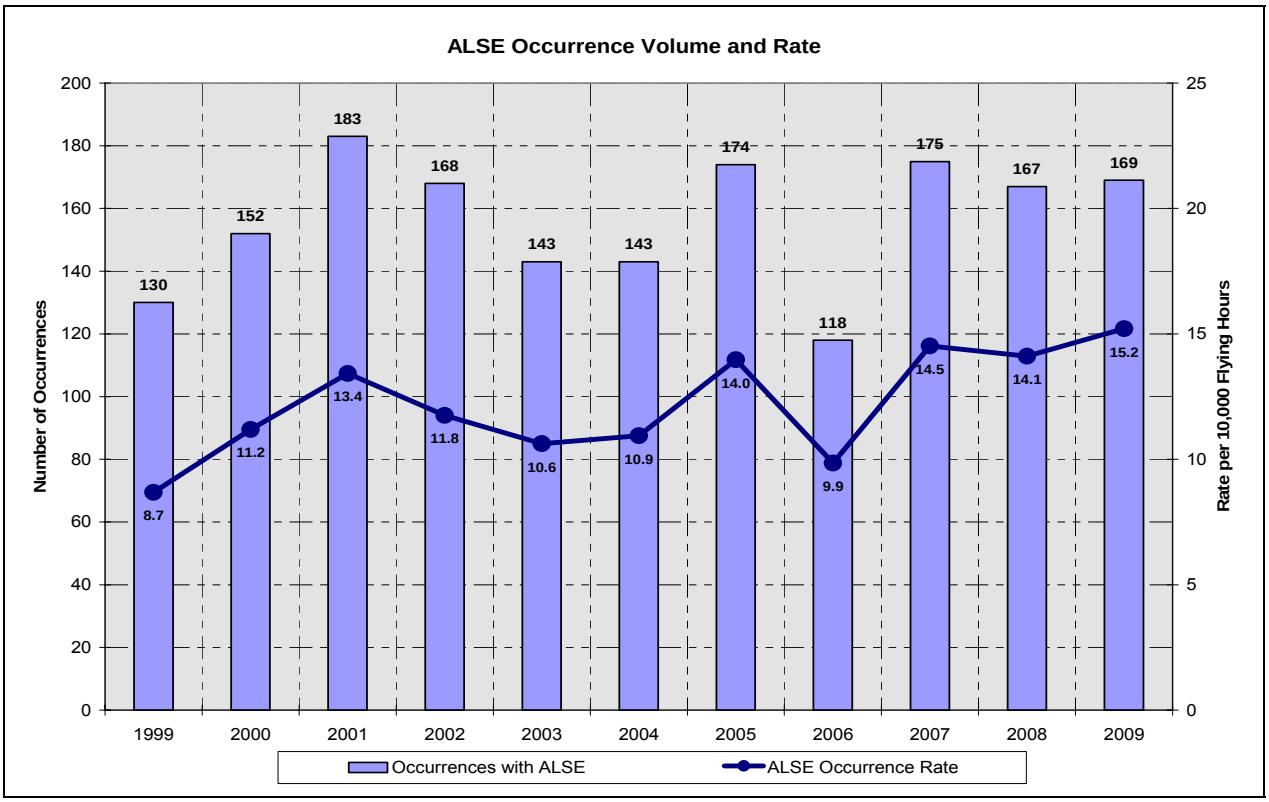
- CH147. Operations in Afghanistan are very challenging due to the dusty conditions. The CH147D Chinook operations involve a high number of take-offs and landings for the purpose of loading / unloading passengers and/or cargo. Two Chinook aircraft almost collided on take-off from an FOB due to lost visual references. Both aircraft had a full

load of passengers on board. In order to mitigate reoccurrence, the Wing took a flight safety pause in the days following the occurrence to highlight the concerns and guidance provided to crews as far as the level of risk to be accepted to conduct/complete their missions.

- CU165. There are no specific flight safety concerns at this time.
- CU170. This aircraft is not listed in Table 18 as there is not sufficient data for statistical analysis. The were no procedure detailing the actions required by the air vehicle operator in the event of an engine failure within 57 km of the airfield and specifically on final approach. Requirements included clear instructions showing recommended altitudes based on distance from the airfield and the subsequent necessary glide and landing profiles based on flap and flapless configurations. A RARM was completed and the chain of command has deemed the risk of operating outside glide range as acceptable.

3.3.4 Aircrew Life Support Equipment (ALSE).

The number of occurrences related to survival and safety equipment in 2009 are not significantly higher than 2008 or the ten year mean (Graph 14). The associated occurrence rate is a marginal increase from the previous year. An increase in the number of occurrences related to ALSE was identified as an Air Force-wide problem in 2007. Although a significant effort has been made since then to address the issues with ALSE, there are still significant deficiencies across all fleets. DFS staff continue to pursue this issue with the Operational Airworthiness Authority (OAA) and the Technical Airworthiness Authority (TAA) staffs through the work of the ALSE WG.



Graph 14 - ALSE Occurrence Volume and Rate

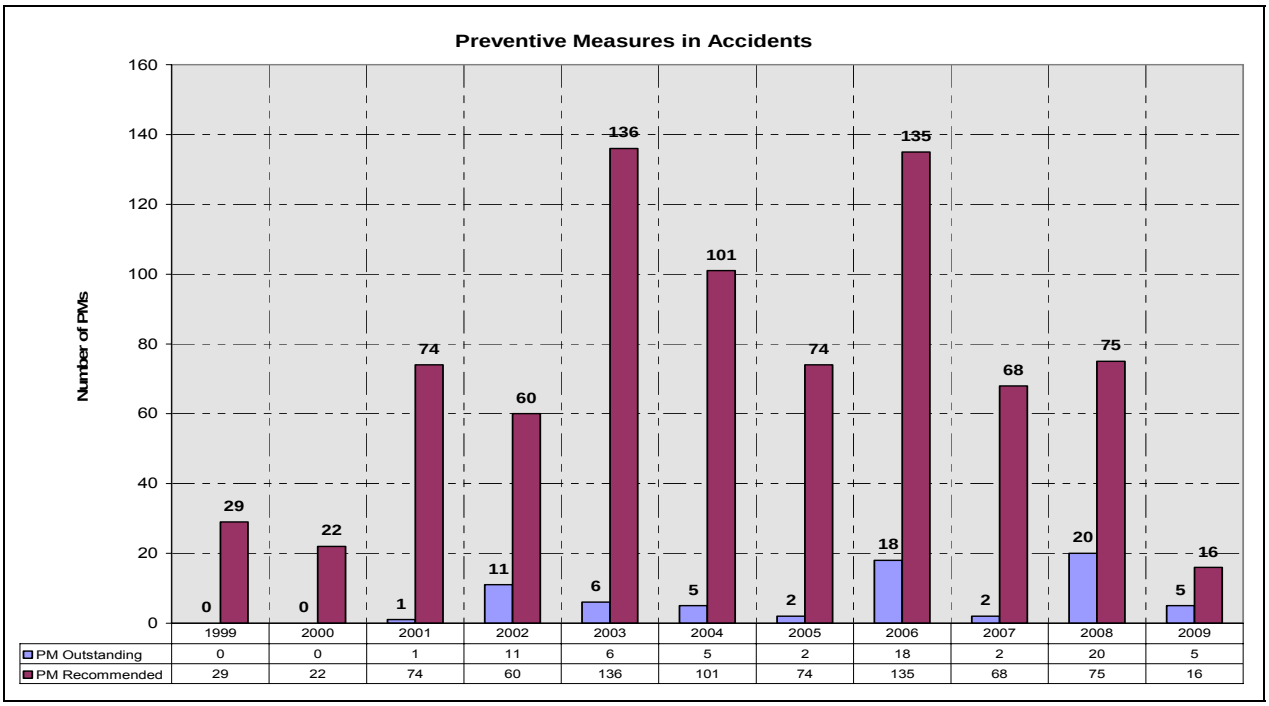
	08	99-08 Mean	99-08 SD	09	D
ALSE RATES	14.1	11.9	2.0	15.2	1.7

Table 19 - ALSE Occurrence Volume and Rate

3.3.5 Preventive Measures

3.3.5.1 Open PM from Class 1 Investigations

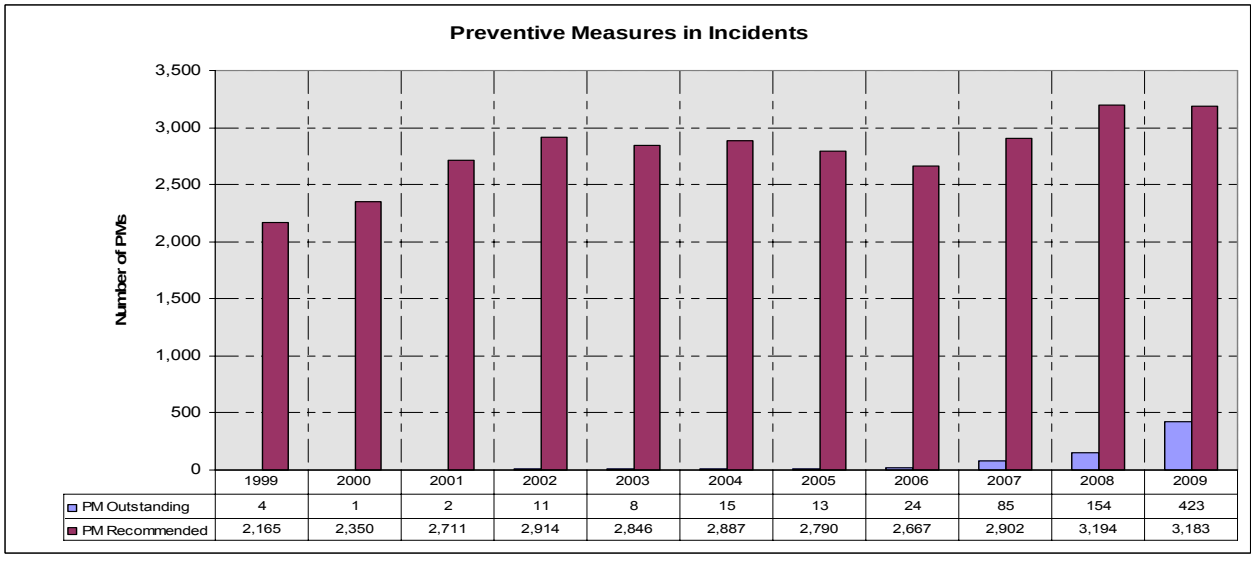
The development of effective Preventive Measures (PM) through FS investigations and their timely staffing/implementation by the chain of command is critical to an effective prevention program. Efforts have been made in the last few years to improve the staffing of PM in terms of time to implement and record management of measures taken or decisions made. There are 43 PM recommended in 2006 or earlier that are still outstanding (Graph 15). The Occurrence/hazards Preventive Measure Working Group that met in Fall 09 made specific recommendations to improve the PM tracking process.



Graph 15 - Preventive Measures from Class 1 Investigations

3.3.5.2 PM from Class 2 to 4 Investigations

Graph 16 provides the breakdown of PM for all classes of investigation except Class 1. Note that as of 31 Dec 09, some investigations were not completed and further PMs may be proposed as a result of investigation activities. The majority of PM for incidents are staffed and closed at unit level, and are thus closed relatively quickly in comparison to Class 1 PM. Still, some 78 Class 2 to Class 4 PM remain outstanding from 2006 and earlier.



Graph 16 - Preventive Measures from Class 2 to 4 Investigations

3.3.5.3 Occurrence and Hazard PM Tracking Working Group (OHPMTWG)

DFS had convened a Working Group to review the processes in place and make recommendations for better tracking and staffing of PM until final disposition. The OHPMTWG met on 28-29 July 2009 at NDHQ Ottawa and made specific proposals to enhance the tracking of all PM from initiation to completion. The processes developed have been discussed with the FS staff and the CoC during the fall. A revised process has been agreed upon and integrated in Amdt #3 of the A-GA-135-001/AA-001 to be published in the spring of 2010. Further, FSOMS has been upgraded to help the tracking of PM and enhance record management.

4. STATISTICAL METHODOLOGIES

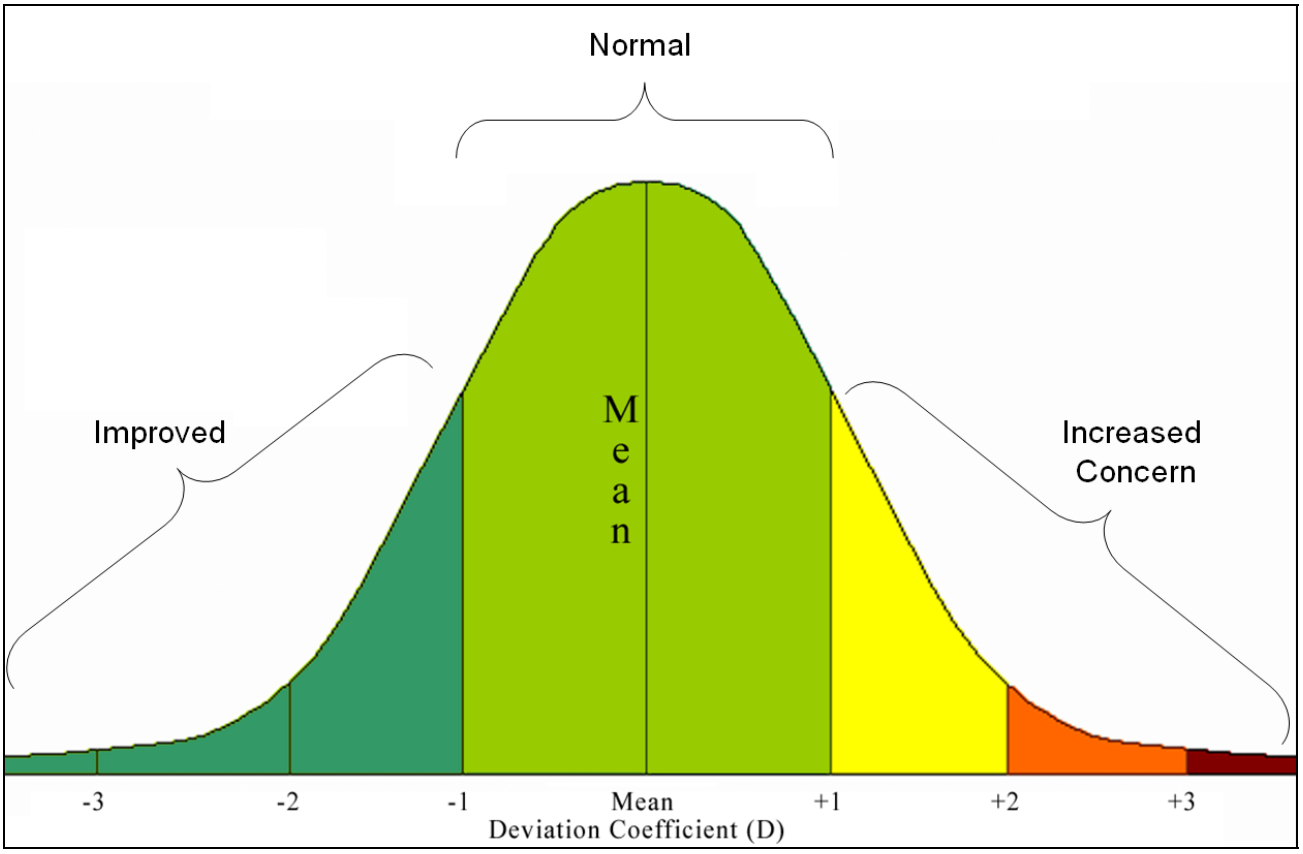
4.1 COEFFICIENT OF DEVIATION VALUE

Data values are typically distributed on either side of the mean value. The DFS Statistician measured how far the values are from mean in order to provide an indication of how standard (within a usual range), or alternatively how abnormal (outside of usual range) the value may be, expressed as the coefficient of the deviation (D). D is calculated using the following formula:

$$D = (\text{Value 2009} - \text{Mean [1999-2008]}) / \text{Standard Deviation (SD)}$$

If the current year D value is similar to ($-1<D\leq1$) the mean of previous periods (5-year, 10-year period), it is colour coded dark green, and would not be of concern. Any value below that ($D<-1$) is considered an improvement and is definitely not of concern although it may warrant examination as to what did trigger the improvement. For any negative trend having a D value greater than 3, it is considered adverse and colour-coded maroon. It represents values of highest concern (Warning) and requires detailed examination. If D is between 2 and 3 ($2<D\leq3$), it is colour-coded orange (Caution), and requires examination. If D is between 1 and 2 ($1<D\leq2$), it is colour-coded yellow (Note) and requires monitoring. When the dataset is not large enough to make a valid statistical inference, the D value is omitted (cell shaded Grey).

FS data sets presented in this report includes the Mean value, SD and the associated D value. Graph 17 below is representative of the methodology.



Graph 17 – Mean, SD and D Representation

4.2 DATASETS

Data was extracted from FS Occurrence Management System (FSOMS) as of 31 Dec 09 with Flying Hours provided to DFS by DGAEPM

4.3 RATE CALCULATIONS

All reported rates are per 10,000 flying hours, except for HFACS data, which depicts a rate per 1000 occurrences. Ideally, the latter rate should have been calculated on the rate per 1000 HFACS related occurrences to achieve even more meaningful trending. Currently FSOMS does not support this function, but will be addressed as a requirement in for FSOMS upgrades. Future plans include gathering extra data to carry out additional statistical modeling/trending with an aim to localizing and identifying specific risk in operations.

4.4 RANDOMNESS LEVEL (RL)

HFACS cause factors and System Descriptor data were analyzed using a statistical method called 'Above and Below-Median Test for Randomness of Numerical Data'. This method produces a randomness related number for every cause factor. A lower RL value indicates the cause factor is appearing in a systemic fashion and is not the result of random fluctuations. Conversely, a high RL value indicates randomness and is not necessarily indicative of a trend.

5. DEFINITIONS

5.1 AIRCRAFT FAMILIES AND CLASSIFICATION CODE

The following outline the family classification and aircraft type in the CF.

FAMILY	CODE	DESCRIPTION
Fighters	CF116	CF5 Freedom Fighter (removed from service in 2003)
	CF188	CF18 Hornet
Helicopters	CH113	Iroquois (removed from service in 2004)
	CH124	Sea King
	CH139	Jet Ranger Bell 206B
	CH146	Griffon
	CH147	Chinook
	CH149	Cormorant
Patrol	CP140	Aurora
Trainers	CT102	Astra
	CT111	Slingsby
	CT114	Tutor
	CT145	King Air
	CT146	Outlaw
	CT155	Hawk
	CT156	Harvard II
Transport	CC115	Buffalo
	CC130	Hercules
	CC138	Twin Otter
	CT142	Dash-8
	CC144	Challenger
	CC150	Polaris (Airbus 310)
	CC177	Globemaster III
UAV	CU161	Sperwer
	CU170	Heron

Table 20 - Aircraft Families

5.2 TERMINOLOGY

The following terms are condensed extracts from A-GA-135-001/AA-001 *Flight Safety for the Canadian Forces*.

5.2.1 Aircraft Damage Level (ADL)

Damage is defined as physical harm to an aircraft that impairs the value or normal function of the aircraft. Damage is said to have occurred when the aircraft or any portion of it is lost or requires repair or replacement as a result of unusual forces like a collision, impact, explosion, fire, rupture, or overstress. The following definitions are used to reflect the degree of damage:

- Destroyed/missing: The aircraft has been totally destroyed, is assessed as having suffered damage beyond economical repair or is declared missing.
- Very serious: The aircraft has sustained damage to multiple major components requiring third-line maintenance.
- Serious: The aircraft has sustained damage to a major component requiring third-line maintenance.
- Minor: The aircraft has sustained damage to non-major components requiring normal second-line maintenance repair.
- Nil: The aircraft, including the power plant, has not been damaged.

5.2.2 Personnel Casualty Level (PCL)

The PCL is a colour-based Categorization system used to identify the most severe casualty suffered by personnel in an FS occurrence. The PCL assigned for an occurrence is defined as follows:

- Black: PCL level assigned when a fatality has occurred.
- Grey: PCL level assigned when personnel are missing.
- Red: PCL level assigned when personnel are very seriously injured or ill and the person's life is in immediate danger.
- Yellow: PCL level assigned when personnel are seriously injured or ill. There is cause for immediate concern but the patient's life is not in immediate danger. Usually the person is non-ambulatory.

- Green: PCL level assigned when personnel are moderately ill or injured in an occurrence for which medical attention is needed but there is no immediate concern. Usually the person is ambulatory.

5.2.3 Occurrence

An occurrence is any event involving the operation of an aircraft or to support flying operations where there is aircraft damage or a personnel casualty, or risk thereof. This definition excludes damage or injury caused by enemy action.

5.2.3.1 Air Occurrence

An air occurrence is an occurrence involving an aircraft between the time the first power plant start is attempted with intent for flight and the time when the last power plant or rotor stops (for a glider, from the time the hook-up is complete until the glider comes to rest after landing).

5.2.3.2 Ground Occurrence

A ground occurrence is an occurrence involving an aircraft when there is no intent for flight, or when there is intent for flight but no power plant start has been attempted, or after the power plants and rotors have stopped.

5.2.4 Occurrence Category

Occurrences are categorized according to the ADL or PCL; whichever is more severe, in the following manner:

- 'A': Destroyed/missing ADL or Black or Grey PCL.
- 'B': Very serious ADL or Red PCL.
- 'C': Serious ADL or Yellow PCL.
- 'D': Minor ADL or Green PCL.
- 'E': Nil ADL and no injury.

5.2.5 Accident

An accident is defined as a Category 'A', 'B', or 'C' occurrence. An accident involving more than one aircraft is counted as only one accident.

5.2.6 Incident

An incident is defined as a Category 'D' or 'E' occurrence. An incident involving more than one aircraft is counted as only one incident.

5.2.7 Supplementary Report (SR)

The SR is the report normally produced by the wing or unit for aircraft incidents of category D and E. It shall be submitted within 30 calendar days of the occurrence.

5.2.8 Enhanced SR (ESR)

The ESR is to be used for occurrences that are suffi ciently complex to warrant a more thorough investigation than a normal SR, but do not require the same degree of scrutiny that is required for an FS Investigation Report (FSIR). The reporting requirements are the same as for the SR except that the investigation paragraph will be more detailed. DFS is the tasking and releasing authority for ESRs.

5.2.9 FS Investigation Report (FSIR)

The FSIR is a comprehensive report on an FS occurrence and all related aspects, so the reviewing authorities have detailed information on which to base recommended PM. The report follows the ICAO accident report format. DFS is the tasking and releasing authority for FSIRs. The FSIR requirements are available on the DFS website. FSIRs shall normally be unclassifi ed and be released to the public via the DFS Internet site and internally to the Department on the Intranet site.

5.2.10 Rate of Occurrences

The rate of occurrences is reported as the number of occurrences per ten thousand flying hours. For example, four accidents in 30,000 flying hours would result in a 1.33 rate.

5.2.11 Cause Factors

A cause factor is defined as any event, condition or circumstances, the presence or absence of which, within reason, increased the likelihood of the occurrence. Cause assessments constitute the basis for the creation and application of preventive measures. Listed below are the definitions for the six cause factors that are assigned to aviation occurrences in the Canadian Forces.

- Personnel: Includes acts of omission or commission, by those responsible in any way for aircraft operation or maintenance or support to operations, and contributing circumstances that lead to a FS occurrence.

- Materiel: Includes failures of all aircraft components, support equipment and facilities used in the conduct and support of air operations that lead to a FS occurrence.

- Environmental: Includes environmental conditions that, if all reasonable precautions have been taken and applied, are beyond human control within the present state of the art that lead to a FS occurrence.

- Operational: Includes operational situations that lead to a FS occurrence in which no other controllable circumstances contributed to that event. The CAS shall approve the specification of this cause factor.

- Unidentified Foreign Object Damage (FOD): Includes occurrences caused by the presence of a foreign object not able to be identified that causes or is assessed as having the potential to cause aircraft damage or personal injury.

- Undetermined: Includes occurrences in which there is not enough evidence to reasonably determine an exact cause.

5.2.12 Human Factors Analysis and Classification System (HFACS)

HFACS is a general human error framework used as a tool for investigating and analyzing the human causes of aviation occurrences.

5.2.13 Preventive Measures

A preventive measure (PM) is any step that can be taken to decrease the likelihood of an aircraft occurrence. When practical, one or more PMs are applied to each cause factor assigned to an occurrence.