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2008

Annual Report on Flight Safety

Canada

TABLE OF CONTENTS

DIRECTOR COMMENTS

This report provides a synopsis of the activities carried out by the Directorate of Flight Safety and gives an analysis of the Flight Safety information collected during 2008.

The theme for the 2008 DFS Briefing Tour, "Flight Safety as a Mission Enabler," focused on two specific areas. First, it highlighted the paramount requirement to ensure our highly successful Flight Safety program continues to play a vital role in domestic and deployed operations. Second, it emphasized the important role the Flight Safety program has to play in the introduction of new aircraft fleets.

The increased workload associated with our deployed operations, the introduction of new fleets, and additional contracted fleets have strained our Flight Safety resources and our capacity to investigate effectively all occurrences. This report indicates some problems areas like the significant increase in the accident rate, the high number of overdue outstanding Preventive Measures, the high number of Exceptional Deviations, the stalled initiatives of Cockpit Voice Recorder/Flight Data Recorder implementation on all fleets. These are causes for concern. The good news is that reporting has been up and that initiatives have been put in place to find solutions to problem areas. The next few years will continue to be very challenging and could provide opportunities to improve investigation procedures and training standards with the release of the Airworthiness Investigator Manual and enhancement to the Flight Safety Occurrence Management System to allow for better staffing and tracking of Preventive Measures. Further research will be done to consider the benefits of using Military Flight Operation Quality Assurance within the Canadian Forces.

Additional issues are wide and varied. We must leverage our excellent Flight Safety culture and capabilities to pedantically address all recognized issues in order to effect improvements and remain proactive.

Feedback on this document is solicited and would be greatly appreciated. Comments should be forwarded to DFS 3 Promotion and Information, Jacques Michaud at Jacques.Michaud@forces.gc.ca.

G.R. Doiron
Colonel
Director of Flight Safety

EXECUTIVE SUMMARY

This report provides a synopsis of the activities carried out in 2008 by Airworthiness Investigative Authority (AIA) and the Directorate of Flight Safety (DFS). It also gives statistical details on flight safety occurrence data collected during the year in comparison with the last ten years and highlights areas of concerns.

AIRWORTHINESS PROGRAM

Investigations. The AIA initiated 26 investigations divided between 23 accidents (nine Category 'A', seven Categories 'B', and seven Category 'C') and three incidents (one Category 'D' and two Category 'E'). A total of 17 investigations were closed. These figures include Air Cadet and UAV investigations.

Bill C-7. The proposed Bill C-7, if adopted, addresses several Department of National Defence (DND) airworthiness concerns, including additional powers for AIA appointed investigators, confirmation of the privileged status of flight safety information, processes to enhance the conduct of DFS/Transportation Safety Board (Air) co-ordinated investigations and the ability to sub-delegate airworthiness authorities. It also introduces better procedures for accident investigations dealing with civilian companies and the next of kin of personnel killed in the Canadian Forces (CF) aircraft accidents. Bill C-7 got to third reading and debate in the last (39th) parliament. Thus far, it has not been re-introduced in the 40th parliament.

Investigation Manual. The Airworthiness Investigation Manual (AIM) is designed to delineate AIA policies. The AIM will outline the basis for AIA standards, procedures and regulations, and detail how the AIA interacts with persons, agencies, companies or authorities both within and outside of DND. It is in production and should be ready by fall 2009.

Amendments to A-GA 135-001/AA-001. Amendment 1 and 2 of the A-GA 135-001/AA-001, *Flight Safety for the Canadian Forces*, was published respectively in April and October 2008. The amendments covered CAS directions on the CVR/FDR policy, total re-write of the Human Factor Accident Classification System taxonomy and expansion of definitions for Air Weapons, Aircraft Store and Non-Expendable Store.

CVR/FDR Working Group. The CVR/FDR Working Group continued its activities during the reporting period. Following the completion of gap analyses to compare the current CVR/FDR capabilities against the technical standards detailed in the CVR/FDR policy, the fleet managers initiated the development of an implementation plan aimed at identifying proposed solutions to close the gap, including alternate means of compliance. The lack of resources has somewhat impeded progress with implementation.

Aviation Life Support Equipment (ALSE). The increase in the number of occurrences related to survival and safety equipment was identified as a fleet wide problem in 2007. Although 2008 has seen a very slight decrease of ALSE related occurrences, there are still significant deficiencies. DFS staff continue to pursue this issue with the Operational Airworthiness Authority (OAA) and the Technical Airworthiness Authority (TAA) staffs.

FLIGHT SAFETY PROGRAM

Promotion. Unit visits and the DFS annual briefing were the primary means of promotion and maintaining contact with personnel involved in FS. The briefing was presented by DFS to 25 different locations covering all Wings as well as Canadian Component - NATO Airborne Early Warning Force Geilenkirchen, Canadian Defence Liaison Staff in Washington and London. Despite staff publisher manning vacancy, DFS was able to release three issues of *Flight Comment* and six issues of the electronic flight safety newsletter Debriefing. The first issue of *On Target* magazine was also released and focussed on ground icing. DFS awarded 4 Good Show and 23 For Professionalism awards, a slight reduction from the previous year based on 34 submissions. The 2007 SICOFFA (Sistema de Cooperación entre las Fuerzas Aéreas Americanas) award was presented during the year to 15 Wing Moose Jaw.

Surveys. DFS conducted Flight Safety surveys at five contractor sites: Standard Aero Ltd in Winnipeg, AVEOS in Montréal, IMP Aerospace Ltd in Halifax, Cascade Aerospace in Abbotsford; and L-3 MAS in Mirabel. 1 Canadian Air Division Flight Safety, augmented with DFS personnel, conducted surveys at 3 Wing, 4 Wing, 12 Wing, 15 Wing, and 443 Squadron.

Training. A total of six Basic Flight Safety Courses were conducted by 1 Cdn Air Div Flight Safety staff which qualified 183 Unit Flight Safety Officers. Further, one regular and one special Advanced Flight Safety Course qualified an additional 28 staff, including one Foreign and one Department of National Defence (DND) contractor.

STATISTICS AND DATA ANALYSIS

Flying Hours and Reporting. Although Unmanned Aerial Vehicles (UAV) hours almost doubled in 2008, the number of hours flown in the CF and for the Air Cadet Glider Program (ACGP) remained relatively steady. (15,487 for Gliders, 126,067 for CF, including 1,994 for UAVs). Personnel reported 2,938 occurrences, of which 56% were classified as Air occurrences. The rate of reporting per 10,000 hrs improved to 208 compared to the 5-year average of 194, indicating a healthy reporting culture.

Occurrences Breakdown. The CF, at least statistically, had a poor FS record in 2008 with seven personnel suffering major injuries (two fatal, two very serious, and three serious). This represents the highest number in the last ten years. A total of nine aircraft were lost (one CT114 Tutor, one CT155 Hawk and seven UAVs). The Air accident rate for the CF was 0.89, almost doubling the 10-year average rate of 0.46. The UAV accident rate remains very high at 80.2, a significant increase from 67.9 in 2007. The ACGP had one very serious injury and 1 serious injury with the total loss of a Schweizer glider and another seriously damaged glider.

Personnel and System Descriptor Trend Analysis. A newly developed statistical algorithm which examines the frequency of occurrences was used to assess the relative randomness of Human Factor Accident Classification System (HFACS) Cause Factors and System Descriptors. The following areas were assessed as having a significant trend: HFACS Perception and Skilled Based errors for Ground occurrences and Supervision for Air Occurrences, System Descriptors for CT156 Harvard II and CP140 Aurora

undercarriage/landing gear and CF188 Hornet overall. This statistical tool is still being refined and findings will have to be further analyzed in conjunction with operational and maintenance staff.

Difference in Air and Ground Cause Factor Attribution. The statistical analysis of cause factors assigned to Air and Ground occurrences shows a marked difference in the attribution of Personnel and Material cause factors. While intuitively, it would be anticipated that the distribution would be similar, a marked difference exists: Air Occurrences (Personnel: 44.3%, Material: 36.6%) and Ground Occurrences (Personnel: 77.1%, Material: 16.1%). This was reported last year and DFS has mandated a study to assess in conjunction with operational and maintenance staff why these differences are in place. This study is on-going.

High Percentage of Exceptional Deviations. A reduction has been noted in the percentage (5.5% in 2007, 3.7% in 2008) and the number (156 in 2007, 116 in 2008) of reported Deviations. Notwithstanding, the Exceptional Deviations far outnumbers Routine Deviation when the reverse would be considered normal. Any Deviation is cause for concerns as it implies a wilful intent to disregard orders and approved procedures. In particular, Exceptional Deviations calls 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 is reviewing these deviations to determine if the findings are valid and what recommendations could be made to the chain of command to help reduce the Exceptional Deviations.

Preventive Measures. The development and timely staffing of effective Preventive Measures (PMs) by FS investigators is critical to an effective prevention program. Efforts have been made in the last few years to improve the staffing of PMs through decreased implementation time and decisions/implementation records management. Limited results have been achieved so far as 214 accident investigations' PMs and 70 incident investigations' PMs developed in 2006 or earlier are still outstanding. DFS has mandated a Working Group to review the processes in place and make recommendations for better tracking and staffing of PMs.

2008 FLIGHT SAFETY ANNUAL REPORT

1. AIRWORTHINESS PROGRAM

1.1 AMENDMENT TO AERONAUTICS ACT (BILL C-7)

Bill C-7, if adopted, addresses several Department of National Defence (DND) airworthiness concerns, including 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 last (39th) parliament. Thus far, it has not been re-introduced in the 40th parliament. A request for status on re-introduction from Transport Canada, the lead Ministry in the amendment initiative, indicated this was not the highest priority for their Ministry. The latest indication is that the amendment could be introduced in the fall of 2009.

1.2 AIRWORTHINESS INVESTIGATIVE MANUAL

This Airworthiness Investigation Manual (AIM) is designed to delineate AIA policies. The manual will outline 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. The AIM is currently in the final stages of revision prior to its first publishing and should be available online via the DFS website by the fall of 2009.

1.3 SURVEYS

Surveys are conducted to measure the effectiveness of the Flight Safety (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 five contractor sites (Standard Aero Ltd in Winnipeg, AVEOS in Montréal, IMP Aerospace Ltd in Halifax, Cascade Aerospace in Abbotsford, and L-3 MAS in Mirabel) as part of the DFS continuous contractors visit program. 1 Canadian Air Division (1 Cdn Air Div) FS staff augmented with DFS personnel conducted surveys at 3 Wing, 4 Wing, 12 Wing, 15 Wing, and 443 Squadron.

1.4 WORKING GROUPS

1.4.1 CVR/FDR Working Group

The CVR/FDR Working Group continued its activities during the reporting period. Following the completion of gap analysis to compare the current CVR/FDR capabilities against the technical standards detailed in the CVR/FDR policy, the fleet managers initiated the development of an implementation plan aimed at identifying proposed solutions to close the gap, including alternate means of compliance. Some fleets managers have submitted implementation

plan that have been endorsed by the AIA. It is anticipated that fleets will have completed their implementation plan by the end of 2009. Subsequently, activities by the CVR/FDR working group will dwindle as no funds are allocated to implement the solutions proposed by the fleets. The lack of funding has already impeded progress with the implementation of the CVR/FDR policy. For example, no progress was made on the decision by the Airworthiness Review Board to establish an omnibus project. The lack of funding also limited the implementation of solutions proposed by some fleet including the CT114 Tutor.

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

The 3rd Flight Safety Occurrence Management System Working Group (FSOMS WG) was held from 4 to 6 March 2008 at the National Defence Headquarters in Ottawa. The WG validated strategic and operational processes for the FS Information Management System (FSIMS). An FSOMS subgroup was established to review current event and system descriptors to more closely align the CF with ICAO and better represent the event classification for trending purposes. The 1st Flight Safety Occurrence Management System Typoc Sub Working Group (FSOMS Typoc SWG) was held from 10 to 11 June 2008 at the National Defence Headquarters in Ottawa. The SWG proposed a new taxonomy for Phase of Flight, Events and Systems Descriptors.

1.5 CANADIAN JOINT HELICOPTER SAFETY ANALYSIS TEAM (JHSAT)

DFS is continuing to provide one member to participate in the analysis process of the JHSAT established by Transport Canada in 2007, to conduct analysis of Canadian civil and military accidents, and provide mitigation strategies for the Joint Helicopter Safety Implementation Team. The DFS representative attended four of the seven meetings. The JHSAT goal is to provide a prioritized assessment of the most safety critical hazards to commercial, private and military rotorcraft in Canadian operations in order to identify intervention strategies to be shared with the International Helicopter Safety Team in support of the international safety initiative and the Canadian Joint Helicopter Safety Implementation Team (JHSIT(C)) that will maximize the likelihood of reducing worldwide helicopter accident rates by 80 percent by 2016. JHSAT is in the process of finalizing the report for accidents that took place in year 2000.

1.6 INVESTIGATIONS

1.6.1 Investigation Summary

During the calendar year, the AIA initiated 26 investigations and closed 17. The investigations were mandated for 23 accidents (nine category ‘A’ damage, seven categories ‘B’, and seven category ‘C’) and three incidents (one category ‘D’ and two category ‘E’). These figures include three Air Cadet investigations and 11 investigations for UAV accidents.

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
FS INVESTIGATION REPORTS						
1	19 Jan 08	C	Serious		Griffon	Near roll over and over torque
2	18 Apr 08	A	Destroyed/BER*	Very serious	Hawk	Engine failure followed by ejections
3	06 Sep 08	A	Destroyed/BER	Very serious	Glider	Premature release
4	09 Oct 08	A	Destroyed/BER	Fatal	Tutor	Controlled flight into terrain during photo mission
ENHANCED SUPPLEMENTARY REPORTS / SUPPLEMENTARY REPORTS						
5	05 Mar 08	A	Destroyed/BER		Sperwer	UAV struck grader after launch
6	13 Mar 08	C	Serious		Hercules	Tail strike
7	15 Mar 08	C	Serious		Griffon	Cargo door departed aircraft and struck main rotor
8	18 Mar 08	A	Destroyed/BER		Sperwer	Crashed shortly after take-off
9	19 Mar 08	E	Nil		Jet Ranger	Near miss
10	22 Mar 08	B	Very Serious		Sperwer	Emergency recovery after launch
11	02 Apr 08	C	Serious		Globemaster III	LOX replenishment failure
12	06 Apr 08	B	Very Serious		Sperwer	Failure to climb after launch
13	05 May 08	A	Destroyed/BER		Sperwer	Crashed shortly after take-off
14	09 May 08	B	Very Serious		Sperwer	Launcher did not provide sufficient acceleration for UAV to remain airborne
15	25 May 08	B	Very serious		Sperwer	Prop strike during launch
16	02 Jul 08	B	Very serious		Cessna	Aircraft off the end of runway during landing
17	07 Jul 08	E	Nil		Hornet	Both engines flamed out after landing due to fuel starvation
18	22 Jul 08	D	Minor		Cormorant	Bags of bolts found inside no. 2 driveshaft
19	28 Jul 08	C	Serious		Hercules	Tail strike on landing
20	09 Aug 08	B	Very serious		Glider	Premature release
21	09 Aug 08	A	Destroyed/BER		Sperwer	Parachute malfunction

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
22	18 Aug 08	B	Very serious		Sperwer	Parachute malfunction
23	22 Aug 08	A	Destroyed/BER		Sperwer	Engine failure
24	04 Sep 08	C	Serious		Hornet	Planing link failure
25	16 Oct 08	C	Serious		Cormorant	Tree strike during night training
26	06 Nov 08	A	Destroyed/BER		Sperwer	Engine failure with post crash fire

Table 1 - List of 2008 AIA Initiated Investigations

* BER: Beyond economical repair

1.6.2 Investigation Details

1.6.2.1 19 Jan 08, CH146488, Accident, cat 'C', Yuma, Arizona, Case ID # 133269

Griffon CH146488 was tasked to transport five passengers from Marine Corps Air Station Yuma to the Yuma Range. It was decided to land on a narrow ledge with only the right skid resting on the ledge and conduct a right skid only insert. At five feet above the touch down, the helicopter suddenly lost lift and abruptly settled with the right skid on the ledge. The belly of the aircraft was punctured as it rolled left. During the manoeuvre, the Flight Engineer and Mission Specialist were partially thrown out their respective doors, but were prevented from being completely thrown out of the aircraft by their 'monkey tail' harness. The helicopter once again became airborne, but it was necessary to conduct some aggressive manoeuvres in order to avoid terrain that was in front of the helicopter which resulted in over torque. The investigation is focussing on site selection, environmental conditions, and helicopter aerodynamics.

1.6.2.2 5 Mar 08, CU161019, Accident, cat 'A', Kandahar, Afghanistan, Case ID # 133768

The launch was conducted in variable winds. The UAV failed to climb, levelled at 12 m and impacted an excavator at 365m from launcher, tearing off the right wing. It was destroyed on impact with the ground. The investigation is ongoing.

1.6.2.3 13 Mar 08, CH130343, Accident, cat 'C', Camp Mirage, Afghanistan, Case ID # 133766

Post flight inspection revealed wear on skid plates and aircraft skin on tail section indicative of a tail strike. The crew was not aware of the tail strike having occurred until they were informed that a witness had observed sparks coming from their aircraft upon landing. 1 Cdn Air Div Transport and Rescue Standardization and Evaluation Team will direct 426 Squadron to draft an amendment to the stretched version of the CC130 training syllabus to include awareness training regarding high descent rate and low-energy landing situations. Pilots shall be made aware of the increased danger of a tail strike in these situations and of the fact that maintaining a pitch angle of less than 7 degrees on landing may not prevent a tail strike.

1.6.2.4 15 Mar 08, CH146427, Accident, cat 'C', Carlsbad, California, Case ID # 133780

Aircraft was returning from an operational training mission and was configured with hinge panel doors removed and cargo doors pinned back. Aircraft was halfway through a right hand on final turn to the runway at 600ft AGL, 95 KIAS and between 30-40 degrees bank when crew heard a loud bang which was immediately followed by severe vibrations. Aircraft captain initiated emergency descent while First Officer declared emergency. Crew landed the aircraft in a grass covered area short of the runway and conducted an emergency shut down. Post shut down inspection of aircraft revealed right hand cabin door was missing and main rotor blade had sustained serious damage.

1.6.2.5 18 Mar 08, CU161027, Accident, cat 'A', Kandahar, Afghanistan, Case ID # 133794

The UAV launched normally with an exit speed of 45.5 m/s then rolled left and pitched down after takeoff. It impacted the ground at 250 m from launcher, well left on flight path. Telemetry parameters were normal except for left roll and pitch down with excessive control inputs being recorded to no effect. The inspection determined that a transistor had opened in the servomotor signal circuit causing it to fail. The failure of this electronic component is considered an isolated incident.

1.6.2.6 19 Mar 08, CH139305/6, Accident, cat 'E', Southport, Manitoba, Case ID # 133821

On 19 Mar 2008, the first Jet Ranger departed Southport airport to conduct student training in 'Area North' of the Southport Flying Area. The helicopter entered the training area and the instructor demonstrated a surprise practice forced landing (PFL) to the student. During the demonstration, the helicopter over-flew a second helicopter that was conducting circuit training in Area North. The second helicopter had just lifted off and was climbing through 300 feet AGL when the first helicopter was observed descending to the right, and within a distance of 30 feet of the second helicopter. As the helicopter doing the practice forced landing commenced an overshoot at 150 feet AGL, they were informed by the second helicopter that a near-miss had occurred.

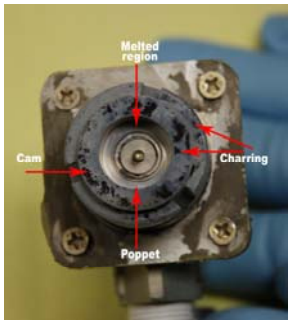
The investigation determined that due to local radio procedures, helicopters entering Area North are unaware of other helicopters operating in the same area and traffic avoidance relies on the 'see and be seen' principle. At the time of the occurrence the local ground conditions of patchy, melting snow produced a dark and light checkerboard pattern that made the visual identification of helicopters below the horizon very difficult. Radio procedures have been developed to de-conflict aircraft operating in the area.

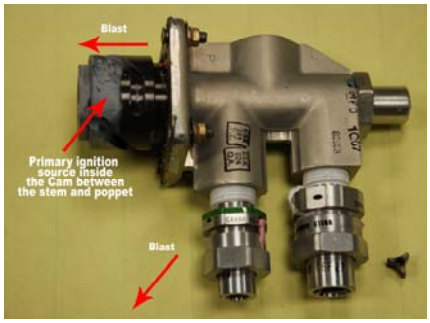
1.6.2.7 22 Mar 08, CU161025, Accident, cat 'B', Kandahar, Afghanistan, Case ID # 133845

The UAV was transiting to operational area, west of the airfield, climbing through 6200 feet when the crew lost all transmissions with the UAV. The Afghanistan National Police located the UAV on the ground which appeared to have completed an emergency recovery. Investigation recommended that the maintenance plan incorporate a foreign object detection check before each flight and the Original Equipment Manufacturer change the circuit so that a short in alternator power does not cause battery power to be removed from circuit.

1.6.2.8 02 Apr 08, CC177703, Accident, cat 'C', Long Beach, California, Case ID # 134008

While disconnecting the liquid oxygen servicing hose filler nozzle from the combination valve, an explosion occurred. The technician handling the servicing hose filler nozzle was seriously injured. The aircraft also sustained serious damage.





The investigation revealed that isopropyl alcohol was used during troubleshooting to remove frost from the outside of the liquid oxygen service hose filler nozzle. The evidence shows that a

small quantity of isopropyl alcohol made it to the crew fill and vent combination valve. Isopropyl alcohol is a highly flammable liquid and will ignite or explode when in contact with liquid oxygen if subjected to a mechanical impact or an electrostatic spark. During the multiple attempts to connect, internal parts of the combination valve made contact creating the ignition source for the liquid oxygen and isopropyl alcohol. The explosion instantly destroyed the oxygen service panel and service hose filler nozzle.

1.6.2.9 6 Apr 08, CU161025, Accident, cat 'B', Kandahar, Afghanistan, Case ID # 133970

The UAV engine rpm dropped below normal parameters a few seconds after launch. UAV began to descend and crew initiated emergency recovery before the UAV hit the ground. The UAV had insufficient height above ground to complete recovery, and impacted ground before parachute deployment. Investigation recommended that alternator maintenance facility adopts more stringent quality assurance methods.

1.6.2.10 18 Apr 08, CT155215, Accident, CAT 'A', Moose Jaw, Saskatchewan, Case ID # 134108

The Hawk training aircraft was climbing through 10,000' above sea level at maximum continuous power when the pilots noticed a change in engine noise, followed shortly afterwards by a T6/NL caution in the rear cockpit, indicative of an engine malfunction.

The qualified instructor took control, zoomed, turned towards the airfield, reduced power to idle and declared a "Mayday". The vibration increased dramatically, followed by a loud bang and the illumination of the oil pressure and generator lights and the loss of the Head-Up display. The instructor realized they were not going to make the runway and commanded ejection. Both pilots successfully ejected at an estimated height of 200 to 300 ft above ground while the aircraft was in a steep descent. Both pilots sustained serious injuries during ejection. The aircraft struck the ground 1.5 seconds after the ejections in a wings level 30 degree nose down attitude and exploded. The investigation is focussing on the engine failure Hawk forced landing procedures and training, and ejection systems issues.

1.6.2.11 5 May 08, CU161022, Accident, cat ‘A’, Kandahar, Afghanistan, Case ID # 134261

Within 10 seconds of launch, the UAV impacted ground 450 m outside of wire, in line with launcher. Witnesses report engine noise dropped off immediately following launch. Investigation is ongoing.

1.6.2.12 9 May 08, CU161002, Accident, cat ‘B’, Wainwright, Alberta, Case ID # 134314

The UAV exited the Robonic launcher when the propeller contacted the tip of the launcher and the UAV crashed approximately 50 meters down range. The UAV suffered significant damage and is being currently assessed as "B" Category. The use of the Robonic launcher by the CF was immediately suspended as a preventative measure.

1.6.2.13 25 May 08, CU161016, Accident, cat ‘B’, Kandahar, Afghanistan, Case ID # 134485

The UAV departed the launcher and began a very shallow climb to 200 feet AGL, and after 20 seconds began to descend with low airspeed. The ground control station crew elected to emergency recover the aircraft at approximately 40 feet AGL. Witnesses reported seeing bits of prop travel perpendicular to launch axis, from the exit end of launcher. Investigation is ongoing.

1.6.2.14 02 Jul 08, Cessna C-172, Accident, cat ‘B’ Lac Etchemin, Québec, Case ID # 134911

The accident involved a Cessna C-172 that departed St-Frédéric airport, QC for the purpose of conducting training as part of the Air Cadet Powered Flight Program. This was the Class 4 instructor pilot’s first time landing at Lac Etchemin, a 2400-foot gravel runway with a slight upslope on the first half of runway 06. Due to a combination of tailwind, excessive groundspeed and ineffective braking technique, the pilot was unable to stop the aircraft on the runway. The aircraft continued off the end of the runway at approximately 25 knots and came to rest in an 8-foot ditch. The aircraft was extensively damaged and the cadet student pilot received minor injuries.

The investigation revealed three main contributing factors as follows:

- A generalized communication breakdown at the organizational and supervisory levels in that key information was not conveyed clearly to all pilots involved.
- A hasty pre-mission planning and briefing during which risk was not properly assessed, leading to unrealistic expectations on the part of the CFI and expectancy on the part of the IP.
- The decision to accept a tailwind and to continue with the landing even though the touchdown point negated the deceleration benefits of the upslope. As a preventive measure, the Flying School has now issued a written policy that restricts instructor pilots from landing on non-paved runways less than 3000 ft.

1.6.2.15 7 Jul 08, CF188931, Accident, cat 'E', Honolulu, Hawaii, Case ID # 134952

While returning to base after a dissimilar aircraft combat training mission, pilot declared emergency fuel prior to landing. After landing, engines flamed out while taxiing due to lack of fuel. Investigation is ongoing.

1.6.2.16 22 Jul 08, CH149909, Accident, cat 'D', Comox, British Columbia, Case ID # 135142

The maintenance crew were in the process of installing the No. 3 drive shaft on the Cormorant helicopter, when they heard a noise coming from the No. 2 drive shaft as it was being rotated. During the inspection of the drive shaft a plastic bag with bolts was found inside. Drive shaft and items found inside quarantined pending further investigation. Investigation is ongoing.

1.6.2.17 28 Jul 08, CC130344, Accident, cat 'C', Kandahar, Afghanistan, Case ID # 135200

Tower notified the crew that sparks were observed coming from the aft fuselage. Tail skid was inspected and damage was found. An Aircrew Information File was promulgated drawing attention to the Caution concerning the restriction at landing for weights above 130,000 pounds.

1.6.2.18 9 Aug 08, Glider, Accident, cat 'B', Picton, British Columbia, Case ID # 135370

The glider student on the first solo flight was at approximately 60' above ground level on takeoff when the rope released from the glider. The glider headed straight ahead, contacting a stand of trees. The student was examined by medical authorities and was complaining of a sore neck. There was extensive damage to both wings of the glider and associated attachment points.

All gliders in the Central region were grounded until a hook assembly inspection was carried out. All aircrew were given an extensive briefing on low-level emergency procedures, student supervision and hook-up technique.

1.6.2.19 9 Aug 08, CU161026, Accident, cat 'A', Kandahar, Afghanistan, Case ID # 135369

At the recovery stage, the UAV continued to roll right for 2 complete revolutions, maintaining a nose down attitude. Just before impacting the ground the UAV pitch levelled and hit the ground at a high rate of descent. The UAV was destroyed on impact. Investigation is ongoing.

1.6.2.20 18 Aug 08, CU161007, Accident, cat 'B', Kandahar, Afghanistan, Case ID # 135444

UAV parachute deployed, but failed to inflate properly. Parachute became tangled, and UAV impacted the ground at a high rate of descent. Front airbag burst on impact. Aircraft sustained relatively high amount of damage, typical of a high g landing. Investigation is ongoing.

1.6.2.21 22 Aug 08, CU161030, Accident, cat 'A', Kandahar, Afghanistan, Case ID # 135496

Engine RPM began to drop and UAV began to descend. Aircrew reported initiating an emergency recovery at 139m AGL. Another observer reported the crashed UAV burning on the ground. Shortly after, local nationals were observed scavenging the UAV. Investigation is ongoing.

1.6.2.22 4 Sep 08, CF188705 , Accident, cat 'C', Inuvik, Northwest Territories, Case ID # 135636

Shortly after touchdown a severe landing gear vibration was felt by the pilot and an overshoot was conducted. After consulting the pilot's checklist, and following a visual inspection of the landing gear by the lead aircraft, a second landing was attempted using an approach end cable engagement. Immediately after touchdown vibrations were once again felt and shortly following cable engagement the LH main landing gear progressively collapsed. Investigation is ongoing.

1.6.2.23 6 Sep 08, Glider Schweizer 2-33A, Accident. cat 'A', Lachute, Québec, Case ID # 135687

The accident flight was the second of two flights that formed the 60-day check for the cadet. Between 80 and 130 feet AGL, the cadet heard a metallic "clunk" sound and, thinking that it was the instructor simulating a rope break, initiated the rope break procedure. After the instructor confirmed that the cadet had released the rope, the instructor took control and initiated a low level steep turn in an attempt to return to the departure runway. The right wingtip contacted the ground during the turn and the glider impacted the ground heavily. It came to rest in an almost vertical nose-low position in a drainage ditch that ran parallel to the runway. The cadet sustained serious injuries and the instructor sustained very serious injuries. The glider was damaged beyond economical repair.

The preliminary investigation has indicated that neither the Tow Plane nor the Glider had suffered mechanical problems prior to the rope release and that the rope was in good condition. The investigation is focussing on training practices and human factors.

1.6.2.24 9 Oct 08, CT114065, Accident, cat 'A', Moose Jaw, Saskatchewan, Case ID # 136094

The accident aircraft was crewed by a pilot in the right seat and a military photographer in the left seat and was part of an authorized four-aircraft dissimilar formation tasked with taking pictures for publicity purposes. The main formation crossed over the Base in "Vic" formation at about 300 feet AGL, then rolled into a 25 degree right bank turn. At this time, the chase aircraft was flying just behind the 3 o'clock line and high above the formation to take a picture of the formation as they passed the tower. The chase aircraft was observed to descend, roll with the formation and fly a slightly convergent path with the formation. It continued in this steady descending turn until it impacted the ground on a heading of 297 degrees magnetic in the approximate 4 o'clock position below the plane of the main formation. Both occupants were killed immediately and the aircraft was destroyed.

The focus of the investigation is on the requisite training and knowledge required for pilots tasked for photo-chase missions. In addition, the investigation is examining the available guidance and direction available with respect to photo-chase missions, and in particular, low altitude photo-chase missions. To date, the investigation has not found any indication of a pre-

existing technical fault with the aircraft or evidence of a bird strike.

1.6.2.25 16 Oct 08, CH149915, Accident, cat 'C', Gander, Newfoundland, Case ID # 136171

During night confined area training, all 5 main rotors blades sustained damage when they came in contact with a tree top. Aircraft landed in confined area without further incident. Investigation is ongoing.

1.6.2.26 6 Nov 08, CU161031, Accident, cat 'A', Kandahar, Afghanistan, Case ID # 136408

The UAV sent a signal to the ground control station crew indicative of an engine failure. The crew elected to activate the recovery immediately before signal was lost with the UAV. A patrol was sent to the likely recovery site and the burning wreckage was located. Investigation is ongoing.

1.6.3 Joint Investigations

The AIA is participating in one coordinated investigation with the TSB (Air) involving a civil registered aircraft (C-FOBX) on 30 Jan 09 and the post-crash response of rescue co-ordination centre Trenton. The investigation was convened and is lead by TSB (Air) with DFS providing a member.

1.6.4 Investigation Report Status

Table 2 outlines the status of ongoing investigations as of 31 Dec 2008.

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
14 May 04	CT155202	On touch and go, Hawk hit birds and crew ejected.	CAS Action Directive being staffed
19 Jun 06	C-FZIQ	Glider was upset by wind gust while being towed.	21-day Letter being staffed
29 Apr 07	CH149902	Engine #3 sprag clutch disengaged.	1 Cdn Air Div RW FSO reviewing Preventive Measures
16 May 07	CF188720	Uncontained turbine failure.	Draft for comment being prepared
18 May 07	CT114159	Tutor Snowbird #2 crashed during show practice.	Pending public release
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
14 Sep 07	CH146454	Mast over torque.	Draft SR being staffed
31 Oct 07	CH149902	Extensive wear damage on swash plate found on daily inspection.	DFS reviewing ESR from 19 Wing

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
03 Nov 07	CH146437	Medium logistic vehicle wheeled struck parked helicopter.	ESR being staffed
17 Nov 07	CU161017	Main gearbox failure.	Draft SR being staffed
19 Jan 08	CH146488	Near rollover and over torque.	Draft FSIR being staffed
06 Mar 08	CU161019	UAV struck grader after launch failure.	ESR being drafted
15 Mar 08	CH146427	Cargo door departed helicopter and struck main rotors.	SR being staffed
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.	ESR being staffed
07 Jul 08	CF188931	CF18 engines flamed out after landing.	ESR being staffed
22 Jul 08	CH149909	Bag of bolts found in #2 driveshaft.	ESR being staffed
22 Jul 08	CC130344	Tail strike on landing.	Epilogue to be posted on DFS website
09 Aug 08	C-FDXP	Premature release of glider.	ESR being staffed
09 Aug 08	CU161026	Parachute failed to function properly during recovery.	SR being staffed
18 Aug 08	CU161007	Parachute failed to function properly during recovery.	SR being staffed
22 Aug 08	CU161030	Engine failure.	SR being staffed
03 Sep 08	CF188705	Planing link fail and gear collapse.	ESR being staffed
06 Sep 08	C-GQYY	Premature rope release.	Draft FSIR being staffed
09 Oct08	CT114065	Tutor crashed during photo mission.	Draft 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 staffed

Table 2 - Investigation Report Status

2. FS 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 "FS is a force enabler to mission accomplishment". The presentation was offered to all Wings in addition to the Canadian Contingent at Geilenchirchen, London and Washington D.C., for a total of 27 units. Despite the position of Publisher being vacant for a few months, DFS published three issues of *Flight Comment* magazine and six issues of the electronic FS newsletter *Debriefing* as well as one issue of *On Target* which focussed on ground icing.

2.2 AWARDS

A total of 34 FS award submissions for individuals or groups were forwarded to DFS, resulting in the granting of 4 *Good Show* and 23 *For Professionalism* awards. Seven individuals were recommended for Squadron or Wing level awards. When compared to the previous reporting period, there were twenty fewer award nominations. During the year, 15 Wing Moose Jaw was presented the 2007 SICOFFA award.

2.3 TRAINING

1 Cdn Air Div FS staff conducted 6 Basic FS Courses qualifying 183 students as Unit FS Officers and non-commissioned members; the breakdown was 6 contractors, 17 air cadet officers, 2 foreign military members and 10 Land Force personnel. The 1 Cdn Air Div conducted one regular and one special Advanced FS Course of 28 students, which included one Foreign and one contractor.

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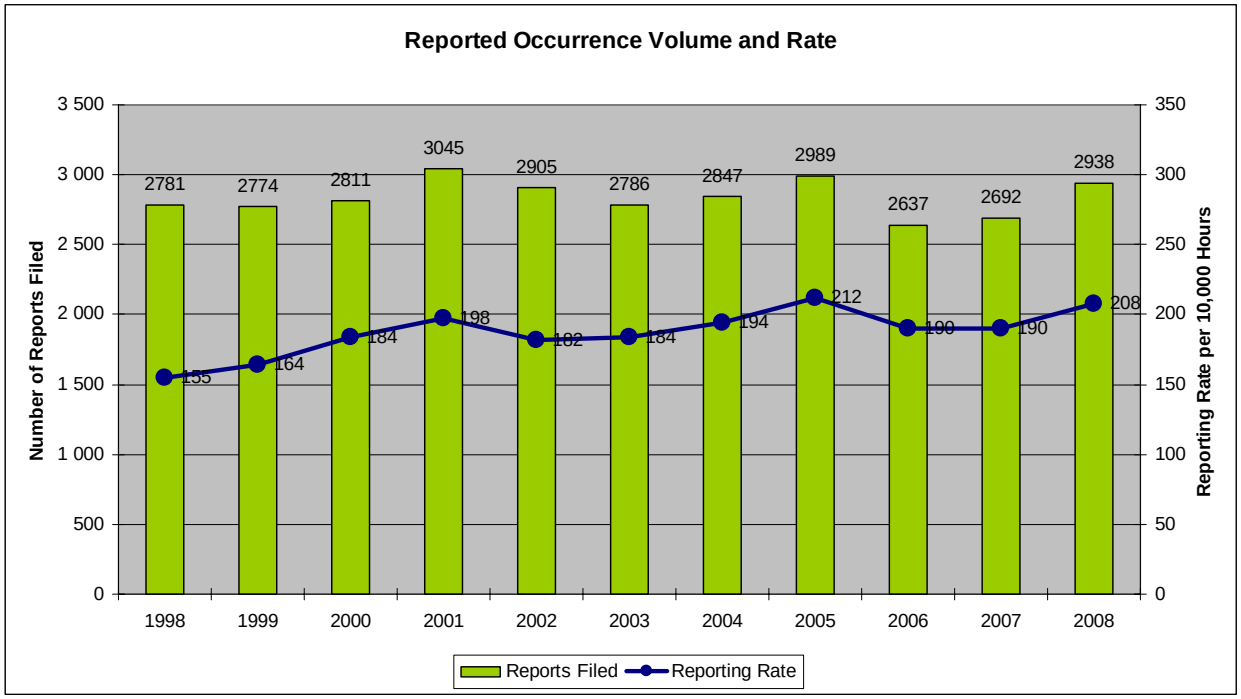
3. STATISTICS AND TREND ANALYSIS

3.1 GENERAL STATISTICS

3.1.1 Reporting Level

As seen in Graph 1, some 2,938 occurrences were reported in the FS Occurrence Management System (FSOMS), which is up from the 10-year mean value of 2,827 per year. The rate of occurrences reported per 10,000 flying hours was 208 which are close to the five year average of 194 which is indicative of a good reporting culture. Approximately 56% of the reported occurrences were classified as air occurrences and the remaining 44% were classified as ground occurrences.



Graph 1 – Reported Occurrence Volume and Rate

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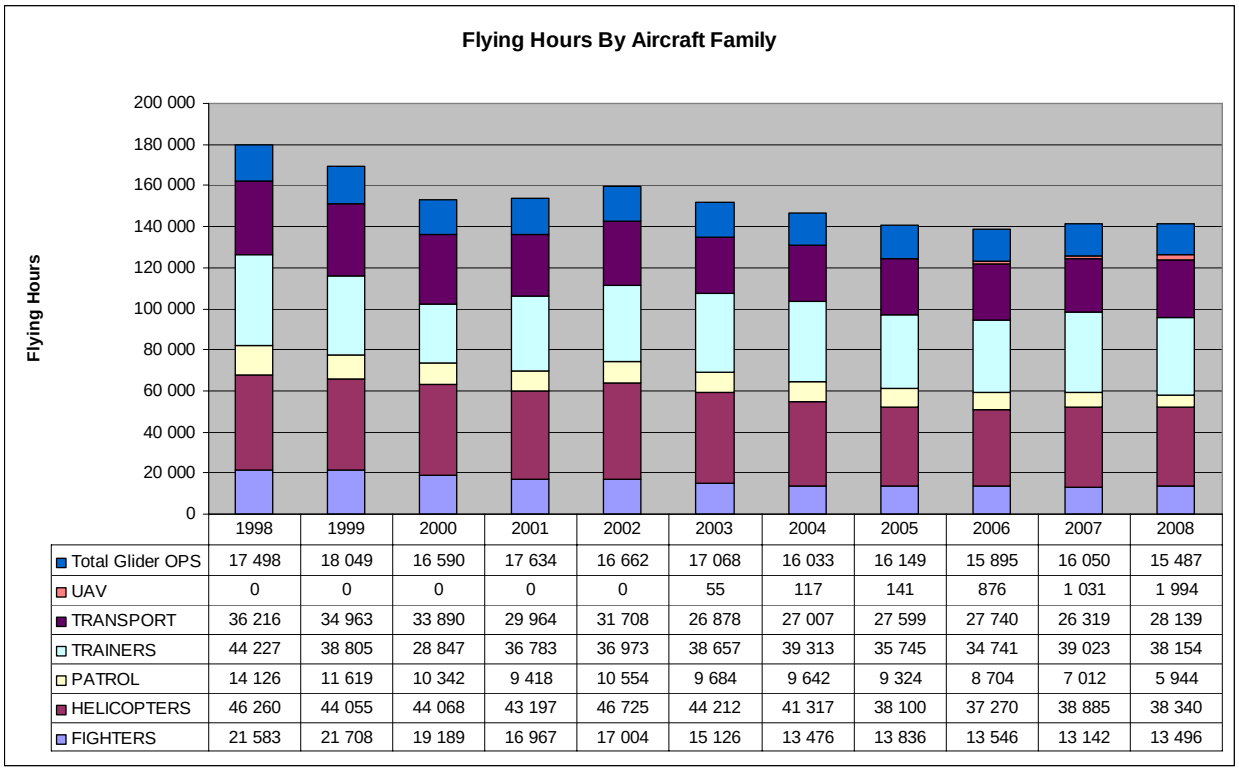
3.1.2 Flying Hours

3.1.2.1 Flying Hours by Family

Overall CF flying hours remained relatively stable with no significant changes except for UAV hours which almost doubled (Graph 2). Flying hours reported for both transport and trainer aircraft differ from the ones reported in the 2007 Annual Report because CC142 Dash 8 hours were transferred from transport to trainer aircraft.



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total Glider OPS	17 498	18 049	16 590	17 634	16 662	17 068	16 033	16 149	15 895	16 050	15 487
UAV	0	0	0	0	0	55	117	141	876	1 031	1 994
TRANSPORT	36 216	34 963	33 890	29 964	31 708	26 878	27 007	27 599	27 740	26 319	28 139
TRAINERS	44 227	38 805	28 847	36 783	36 973	38 657	39 313	35 745	34 741	39 023	38 154
PATROL	14 126	11 619	10 342	9 418	10 554	9 684	9 642	9 324	8 704	7 012	5 944
HELICOPTERS	46 260	44 055	44 068	43 197	46 725	44 212	41 317	38 100	37 270	38 885	38 340
FIGHTERS	21 583	21 708	19 189	16 967	17 004	15 126	13 476	13 836	13 546	13 142	13 496

Graph 2 - Flying Hours by Aircraft Family

3.1.2.2 Flying Hours by Aircraft Type

AIRCRAFT TYPE	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Total	162411	151150	136335	136329	142964	134612	130872	124745	122875	125412	126184
CC115	2424	2492	2967	2316	2120	2439	1839	2533	2065	1762	1698
CC130	22036	21556	20716	17902	19308	14945	15839	15442	16486	14870	14359
CC137	0	0	0	0	0	0	0	0	0	0	0
CC138	2995	2550	2758	2455	1856	1923	1834	1962	1581	2166	2165
CC144	3213	2821	2881	2963	3157	2812	2979	2815	2706	2445	2712
CC150	3923	4154	4079	4328	5267	4760	4516	4847	4903	4483	4666
CC177	0	0	0	0	0	0	0	0	0	593	2556

AIRCRAFT TYPE	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CF116	64	173	130	116	68	18	0	0	0	0	0
CF188	21519	21536	19058	16851	16936	15108	13476	13836	13546	13142	13496
CH113	5854	6066	6306	5366	4040	1626	464	0	0	0	0
CH118	0	0	0	0	0	0	0	0	0	0	0
CH124	9291	9068	9008	10576	10546	8226	8487	6857	6944	7628	7984
CH135	0	0	0	0	0	0	0	0	0	0	0
CH136	0	0	0	0	0	0	0	0	0	0	0
CH139	5877	5602	6121	6527	6666	6070	6371	5024	4613	4852	5684
CH146	25238	23319	22633	20489	22277	23384	21426	21632	21150	21465	19655
CH147	0	0	0	0	0	0	0	0	0	0	4
CH149	0	0	0	239	3196	4906	4568	4586	4563	4939	5073
CP140	14126	11619	10342	9418	10554	9684	9642	9324	8704	7012	5944
CT102	0	0	0	0	0	0	0	0	2118	3805	4898
CT111	3747	4730	3879	4073	3230	2994	4163	3079	0	0	0
CT114	25330	22983	12508	3477	4088	3894	3903	3757	4101	3912	3911
CT133	8293	4602	3116	5122	1586	448	336	74	0	0	0
CT142	4183	3773	2753	2259	2304	2328	2446	2660	2760	2483	2059
CT145	4300	4108	4274	3708	3951	4771	5079	3271	2141	3381	3087
CT146	0	0	0	0	0	0	0	38	93	67	980
CT155	0	0	592	5128	7342	8383	8446	9137	8806	8714	6706
CT156	0	0	2213	13016	14474	15838	14942	13728	14722	16661	16554
CU161	0	0	0	0	0	55	117	141	876	1031	1725
CU170	0	0	0	0	0	0	0	0	0	0	269

Table 3 - Flying Hours by Aircraft Type

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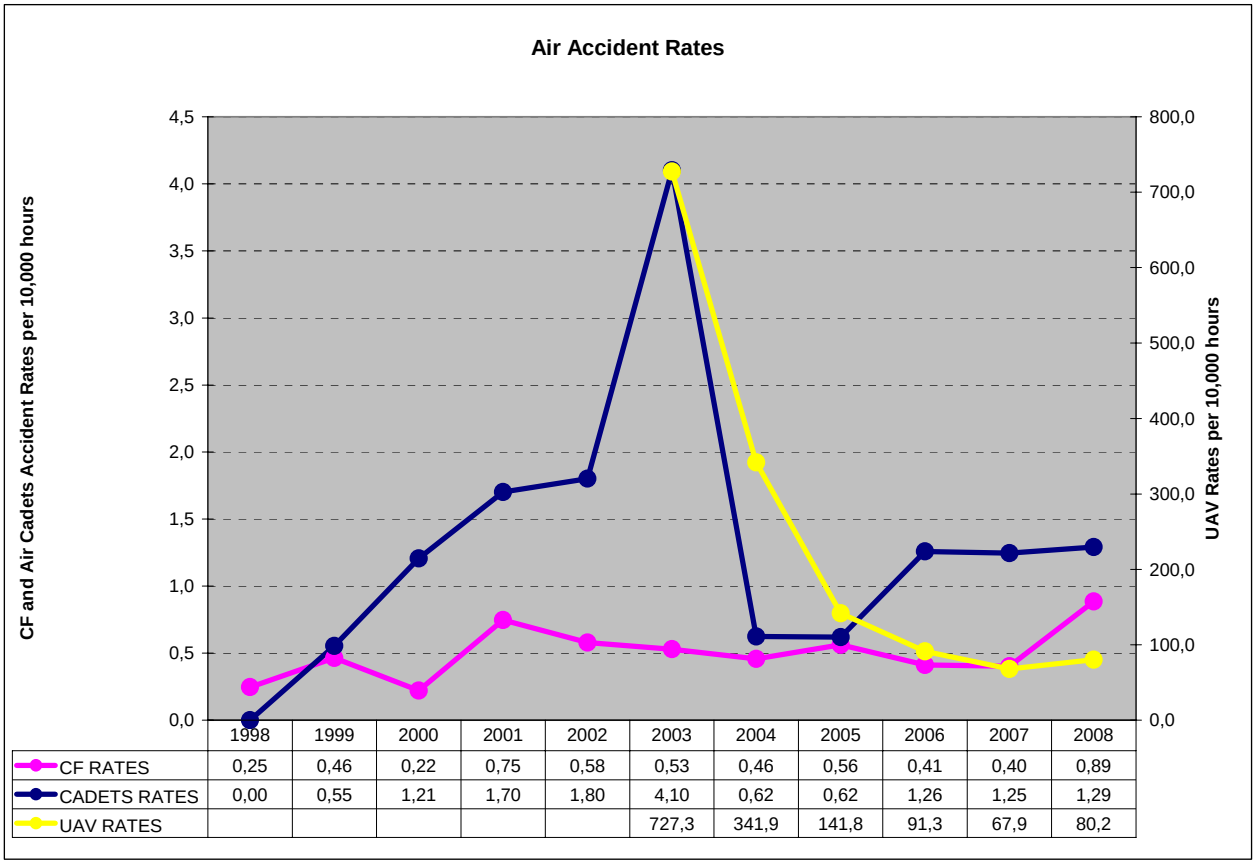
3.1.3 Accident Rate

3.1.3.1 Air Accident Rate

The air accident rate for 2008, exclusive of UAVs and Air Cadets accidents, was 0.89 per 10,000 flying hours (Graph 3). This represents a significant increase from the 10-year CF average of 0.46 but no systemic trends have been detected. The breakdown of air accidents was two category ‘A’ accidents (CT114 Tutor, CT155 Hawk) and seven category ‘C’ accidents (two CH146 Griffon, two CC130 Hercules, one CH149 Cormorant, one CF188 Hornet and one CC177 Globemaster III).

The accident rate for UAVs (80) increased slightly since last year (67.9). The Air Cadet accident rate remained steady (1.29) and is within the historical norms for Air Cadet flying. Given air cadet glider flying operations involve a very large number of flights of very short duration, an elevated rate in comparison to other fleets is expected.



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
CF RATES	0,25	0,46	0,22	0,75	0,58	0,53	0,46	0,56	0,41	0,40	0,89
CADETS RATES	0,00	0,55	1,21	1,70	1,80	4,10	0,62	0,62	1,26	1,25	1,29
UAV RATES						727,3	341,9	141,8	91,3	67,9	80,2

Graph 3 – Air Accident Rates

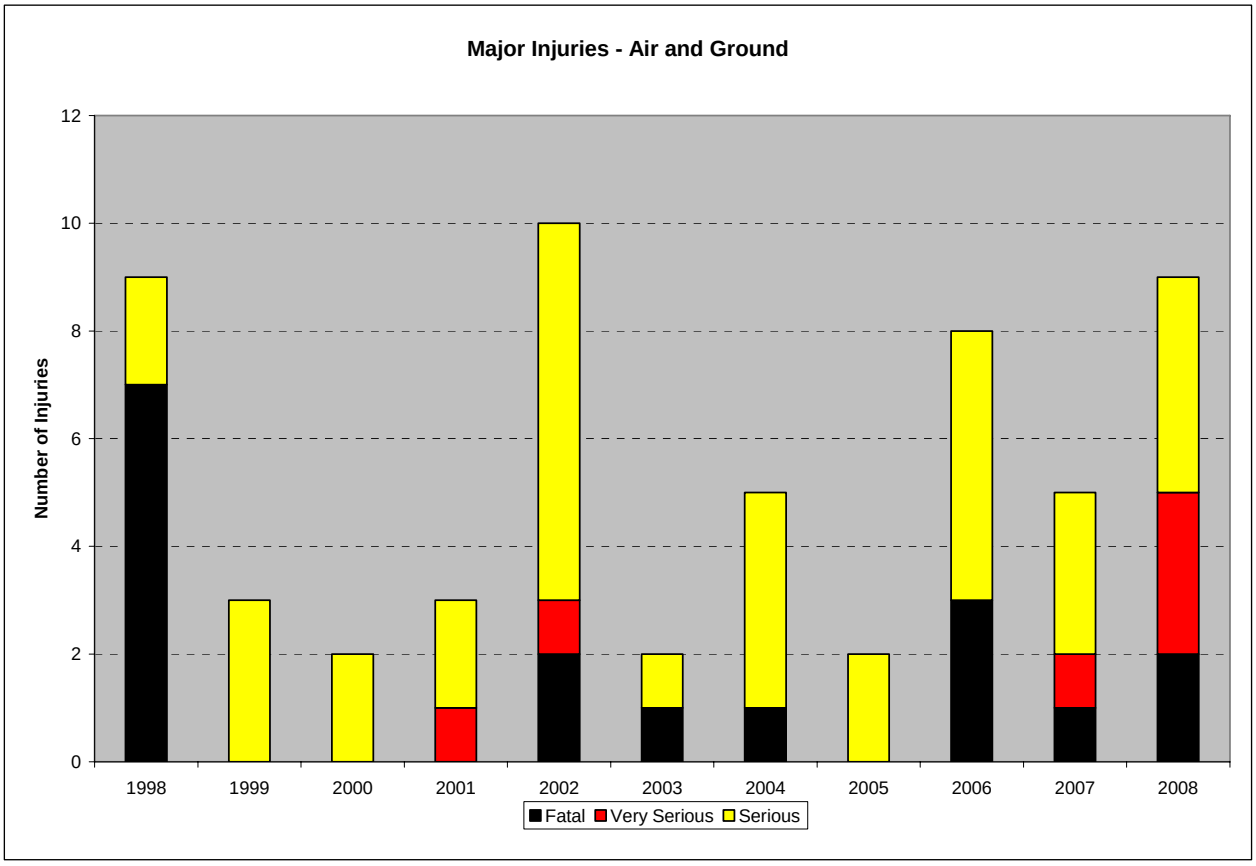
3.1.3.2 Aircraft Destroyed/written-off

Nine aircraft were destroyed: one CT114 Tutor, one CT 155 Hawk and seven UAVs. The TUAV write-off rate is significantly worse than last year's because of several category ‘A’ accidents which have occurred in deployed in-theatre operations.

3.1.4 Fatalities and Injuries

3.1.4.1 Major Injuries

There were two fatal injuries due to the CT114 Tutor accident (9 Oct 08). Two pilots suffered very serious injuries as a result of a CT-155 Hawk that crashed while on final emergency forced landing (18 Apr 08), and a cadet suffered very serious injuries during low level glider release (6 Sep 08). Additionally, four serious injuries occurred during the year: one civilian contractor, one cadet, one maintenance and one traffic technician.



Graph 4 – Major Injuries (includes Air Cadet Glider Program)

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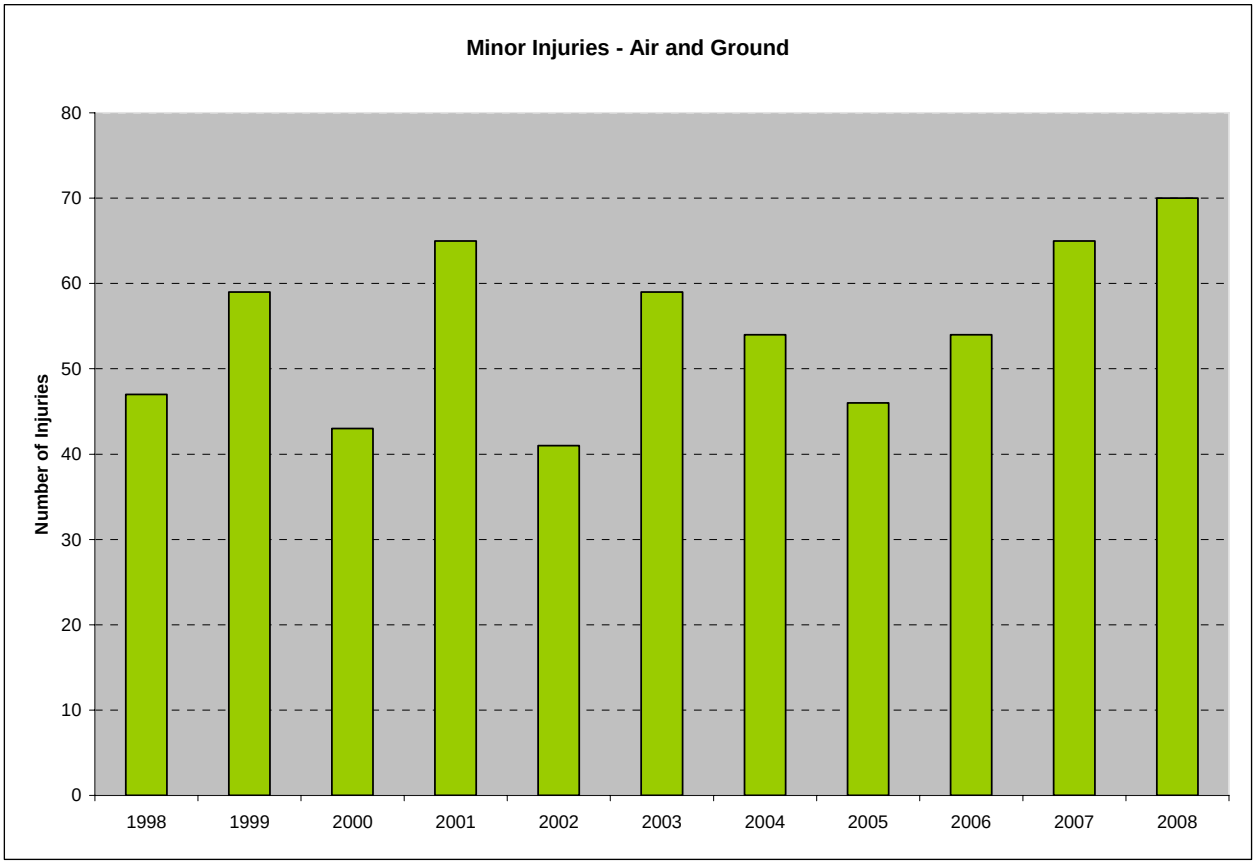
3.1.4.2 Minor Injuries

A total of 70 minor injuries occurred in 2008, up from 65 in 2007.



Graph 5 - Minor Injuries

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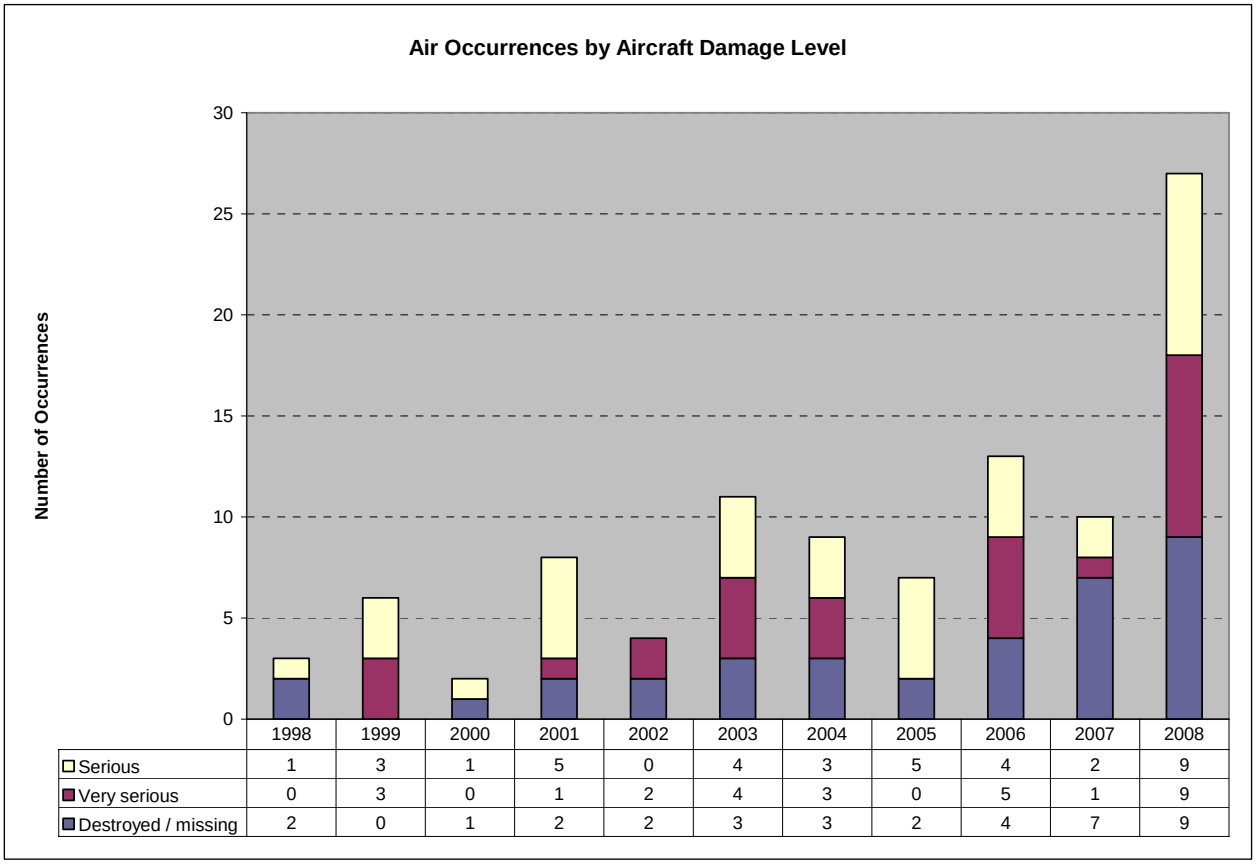
3.1.5 Damage Level

3.1.5.1 Major Air Occurrences by Aircraft Damage Level



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Serious	1	3	1	5	0	4	3	5	4	2	9
Very serious	0	3	0	1	2	4	3	0	5	1	9
Destroyed / missing	2	0	1	2	2	3	3	2	4	7	9

Graph 6 – Major Air Occurrences by Aircraft Damage Level

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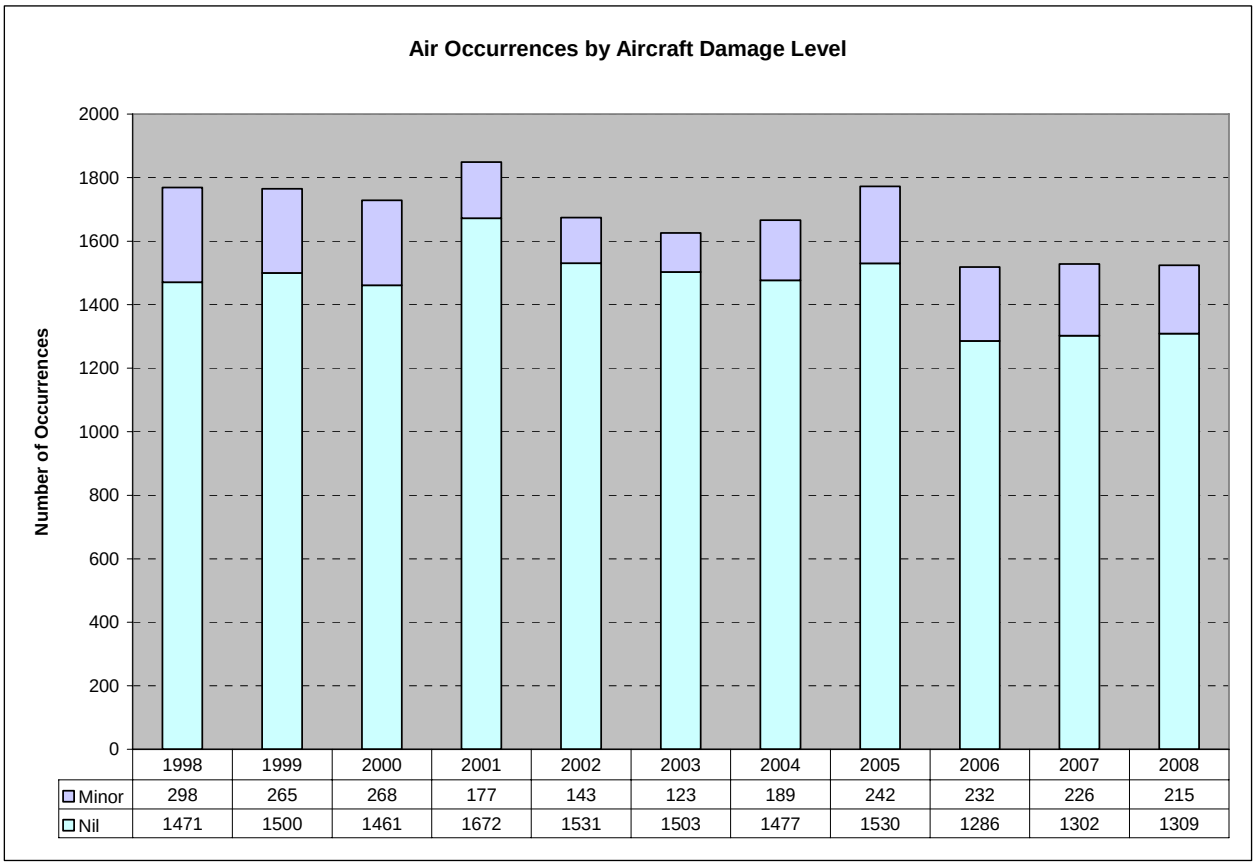
3.1.5.2 Minor Air Occurrences by Aircraft Damage Level



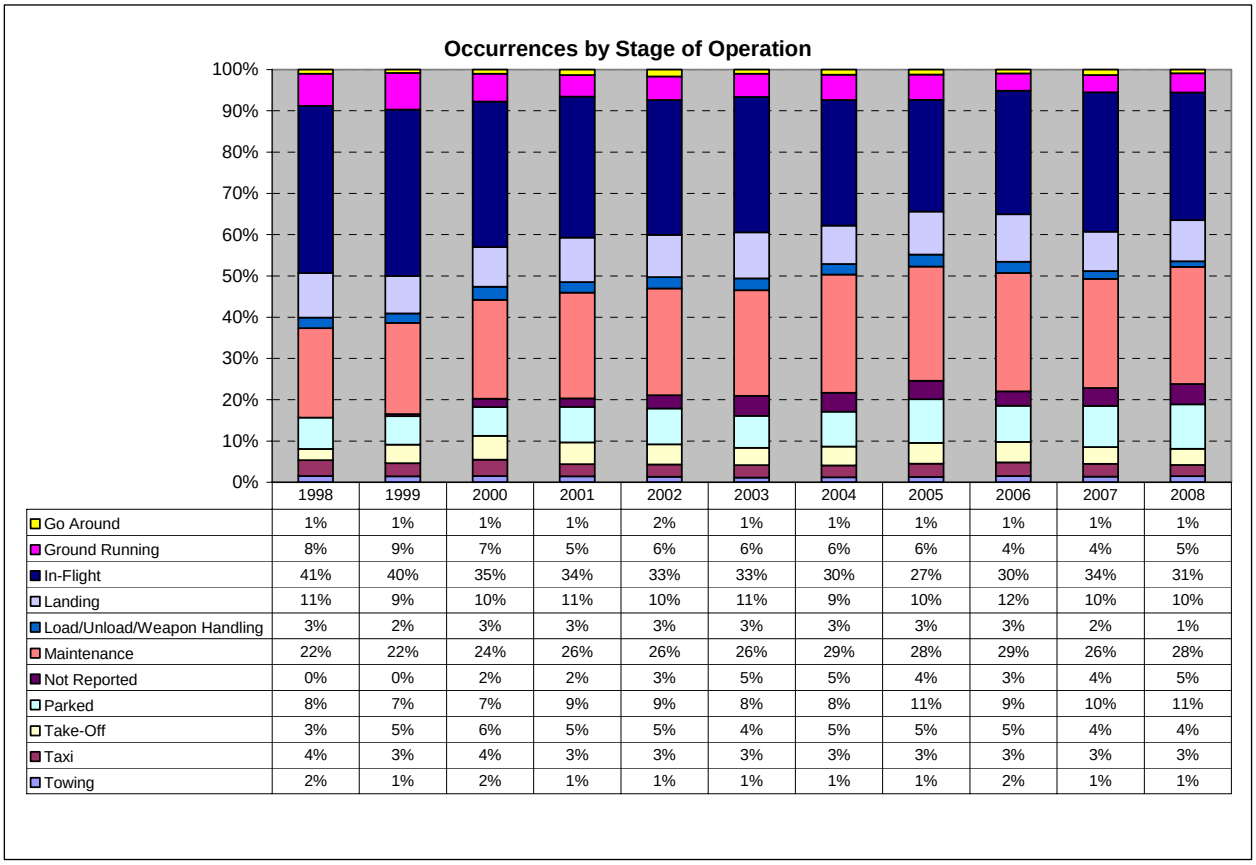
Graph 7 – Minor Air Occurrences by Aircraft Damage Level

3.1.5.3 Ground Occurrences by Aircraft Damage Level

DAMAGE	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Destroyed / missing	0	0	0	0	0	0	0	0	0	0	0
Very serious	0	0	0	0	0	1	0	0	0	1	0
Serious	1	1	0	0	0	0	2	1	0	3	5
Minor	327	252	242	192	181	152	279	322	285	275	348
Nil	630	660	706	880	918	888	796	803	709	749	858

Table 4 – Ground Occurrences by Aircraft Damage Level

3.1.6 Occurrences by Stage of Operation



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Go Around	1%	1%	1%	1%	2%	1%	1%	1%	1%	1%	1%
Ground Running	8%	9%	7%	5%	6%	6%	6%	6%	4%	4%	5%
In-Flight	41%	40%	35%	34%	33%	33%	30%	27%	30%	34%	31%
Landing	11%	9%	10%	11%	10%	11%	9%	10%	12%	10%	10%
Load/Unload/Weapon Handling	3%	2%	3%	3%	3%	3%	3%	3%	3%	2%	1%
Maintenance	22%	22%	24%	26%	26%	26%	29%	28%	29%	26%	28%
Not Reported	0%	0%	2%	2%	3%	5%	5%	4%	3%	4%	5%
Parked	8%	7%	7%	9%	9%	8%	8%	11%	9%	10%	11%
Take-Off	3%	5%	6%	5%	5%	4%	5%	5%	5%	4%	4%
Taxi	4%	3%	4%	3%	3%	3%	3%	3%	3%	3%	3%
Towing	2%	1%	2%	1%	1%	1%	1%	1%	2%	1%	1%

Graph 8 - Occurrences by Stage of Operation - Air and Ground (Air Cadets, Non-CF and UAVs excluded)

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3.2 ANALYSIS

3.2.1 Randomness Statistical Algorithm

Randomness for HFACS Cause Factors and System Descriptors was assessed using a statistical algorithm which examines the frequency of occurrences. Patterns are identified by examining how often a type of occurrence happens, and when (weekly, monthly, yearly, etc). A series of occurrences is said to be statistically random when it contains no recognizable patterns or regularities. A low level of randomness suggests a possible problem and will require further analysis to detect the cause of the pattern / problem.

3.2.2 HFACS Analysis

FSOMS HFACS cause factors data from 2007 and 2008 was analyzed using a statistical method called 'Above and Below-Median Test for Randomness of Numerical Data'. The method produced a randomness related number (%) for every cause factor. A lower percentage indicates the cause factor is appearing in a systemic and not the product of random fluctuations. A strong statistical trend, colour coded red, suggests there is something unusual or unexpected within the identified cause factor that may need to be investigated. Conversely, a high percentage, colour coded green, indicates randomness or no significant trend. In summary, randomness of a cause factor is a desired state. For factors showing a red code, a more detailed analysis of the data could be warranted to understand the non randomness and determine if a problem exists.

It should be noted that the reporting methodology for personnel factors has changed in 2004 prohibiting the production of 10-year statistics. Further, the HFACS taxonomy was modified in 2007. The migration of legacy data is only complete for year 2007 and 2008. Once the legacy data will have been completed for 2004 to 2006, DFS will conduct a comprehensive analysis of the HFACS data.

CAUSE FACTORS		TYPE	NUMBER OF OCCURRENCES	
			2007	2008
ACTIVE FAILURES				
ERRORS	Decision Error	Air	200	223
		Ground	225	262
	Perception Error	Air	36	87
		Ground	13	59
	Skilled Based Error	Air	631	570
		Ground	611	671

CAUSE FACTORS		TYPE	NUMBER OF OCCURRENCES	
			2007	2008
ACTIVE FAILURES (cont.)				
DEVIATIONS	Routine Deviation	Air	6	10
		Ground	15	18
	Exceptional Deviation	Air	41	12
		Ground	94	73
LATENT CONDITIONS				
CONDITIONS OF PERSONNEL	Mental State	Air	505	485
		Ground	494	588
	Physical / Mental Capabilities	Air	87	74
		Ground	88	96
	Physiological States	Air	12	5
		Ground	8	5
WORKING CONDITIONS	Technological Environment	Air	44	41
		Ground	40	47
	Physical Environment	Air	46	68
		Ground	50	67
PRACTICES OF PERSONNEL	Resource Management	Air	115	128
		Ground	100	143
	Personal Readiness	Air	1	4
		Ground	1	0

CAUSE FACTORS		TYPE	NUMBER OF OCCURRENCES	
			2007	2008
LATENT CONDITIONS (cont.)				
SUPERVISION	Planned Activities	Air	24	19
		Ground	34	47
	Problem Correction	Air	11	11
		Ground	24	34
	Supervisory Deviation	Air	6	3
		Ground	13	19
	Level Of Supervision	Air	85	78
		Ground	148	179
ORGANIZATIONAL INFLUENCES	Organizational Climate	Air	17	8
		Ground	28	30
	Organizational Process	Air	39	37
		Ground	81	71
	Resource Management	Air	17	16
		Ground	37	36

Table 5 - Air & Ground Occurrences - HFACS Cause Factor Breakdown

Legend:

Randomness Related %	0 – 9%	10 – 29%	30 – 59%	60 - 100%	n/a
Randomness Level Colour Code	Very low	Low	Medium	High	Not enough data to apply method

Significant Trend ⟷ No Trend

3.2.3 Comparison Routine and Exceptional

A reduction has been noted in the of the percentage (5.5% in 2007, 3.7% in 2008) and the number (156 in 2007, 116 in 2008) of reported Deviations (Table 6). Notwithstanding, the Exceptional Deviations far outnumbers Routine Deviation when the reverse would be considered normal. Any Deviation is cause for concerns as it implies a wilful intent to disregard orders and approved procedures. In particular, Exceptional Deviations calls 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 is reviewing these deviations to determine if the findings are valid and what recommendations could be made to the chain of command to help reduce the Exceptional Deviations.

DEVIATIONS	2004	2005	2006	2007	2008
Routine	61	35	37	21	29
Exceptional	116	118	138	135	87
Total Deviations	177	153	175	156	116
Total Occ	2047	2989	2637	2852	3118
% Dev/Occ	8.6	5.1	6.6	5.5	3.7

Table 6 – Routine vs Exceptional Deviations

3.2.4 System Descriptor Analysis

A/C TYPE	TREND DETECTED	Rate per 10,000 hours		
		10 Year Mean Rate 1998-2007	2007	2008
OVERALL		168.2	169.4	166.9
CC115 Buffalo	**CC115 Overall**	**233.2**	**329.1**	**459.3**
	Weapons Systems	29.0	68.1	76.5
	Electrical Systems	22.5	28.4	58.9
	Fuel Systems	4.8	0.0	35.3
CC130 Hercules	**CC130 Overall**	**210.3**	**248.8**	**314.1**
	Other	4.8	15.5	47.4
	Weapons Systems	9.9	17.5	27.9
	Panels / Doors / Transparent Areas	18.6	24.2	23.0
CF188 CF18 Hornet	**CF188 Overall**	**337.8**	**370.6**	**323.8**
	Weapons Systems	59.5	94.4	68.2
	Undercarriage (Landing Gear)	42.5	48.7	49.6
	Survival & Safety Equipment	25.9	31.2	34.1
CH124A See King	**CF124 Overall**	**201.6**	**183.5**	**180.4**
	Weapons Systems	12.8	13.1	26.3
	Helo Main Rotor / Rotor Head / Rotor Drive Train	17.7	7.9	16.3
	Survival & Safety Equipment	10.8	17.0	16.3
CH146	**CH146 Overall**	**141.2**	**121.6**	**119.6**

A/C TYPE	TREND DETECTED	Rate per 10,000 hours		
		10 Year Mean Rate 1998-2007	2007	2008
Griffon	Helicopter Flight Controls	21.4	19.6	18.3
	Gearboxes / Accessories / Drives	5.4	7.9	14.2
	Helo Main Rotor / Rotor Head / Rotor Drive Train	9.9	13.5	13.2
CH149 Cormorant	**CH149 Overall**	**147.8**	**243.0**	**250.3**
	Helicopter Flight Controls	26.3	36.4	55.2
	Furnishings And Loose Equipment	20.7	28.3	47.3
	Electrical Systems	7.6	14.2	19.7
CP140 Aurora	**CP140 Overall**	**229.9**	**248.1**	**277.6**
	Electrical Systems	20.8	25.7	38.7
	Weapons Systems	18.9	15.7	23.6
	Undercarriage (Landing Gear)	16.2	17.1	20.2
CT114 Tutor	**CT114 Overall**	**118.8**	**204.5**	**150.9**
	Survival & Safety Equipment	9.5	17.9	33.2
	Undercarriage (Landing Gear)	16.8	17.9	33.2
	Fuselage / Wings / Empennage	17.6	28.1	15.3
CT155 Hawk	**CT155 Overall**	**145.0**	**154.9**	**123.8**
	Undercarriage (Landing Gear)	28.3	28.7	31.3
	Fuselage / Wings / Empennage	30.5	35.6	20.9
	Survival & Safety Equipment	13.6	9.2	16.4
CT156 Harvard II	**CT156 Overall**	**113.1**	**83.4**	**94.8**
	Undercarriage (Landing Gear)	37.2	22.8	29.6
	Survival & Safety Equipment	14.5	11.4	10.3
	Flaps	7.1	16.8	8.5

Table 7 - System Descriptor by Fleet

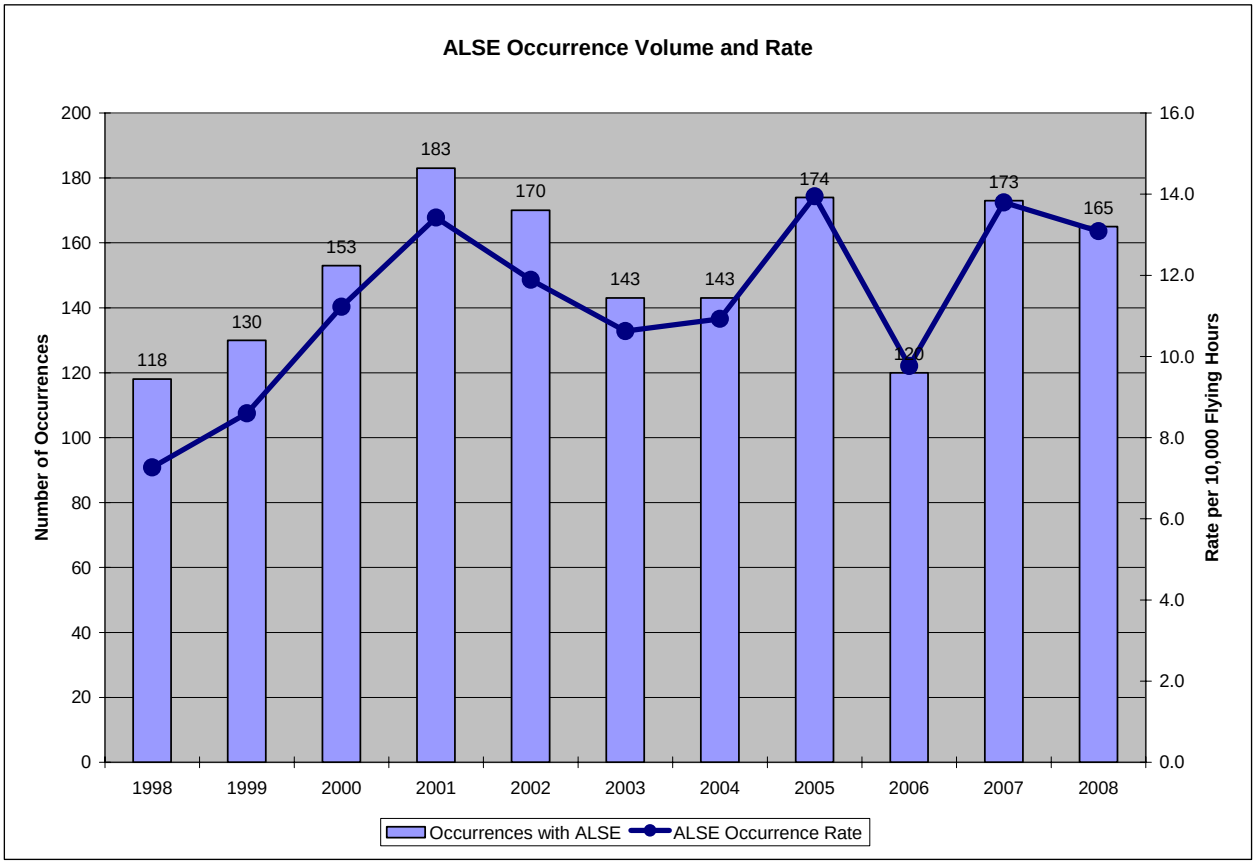
Legend:

	0 – 9%	10 – 29%	30 – 59%	60 - 100%	n/a
Randomness Level	Very low	Low	Medium	High	Not enough info to apply method

Significant Trend ⟷ No Trend

3.2.5 Aviation Life Support Equipment Analysis

The increase in the number of occurrences related to survival and safety equipment in several fleets was identified as a fleet wide problem in 2007. Graph 9 shows a very slight decrease of Aviation Life Support Equipment (ALSE) related occurrences over the last year. This reinforced the concerns reported in a number of recent FS Investigation Reports (FSIRs) in which ALSE was found to be deficient. DFS staff continues to pursue actively this issue with the OAA and the TAA staffs.



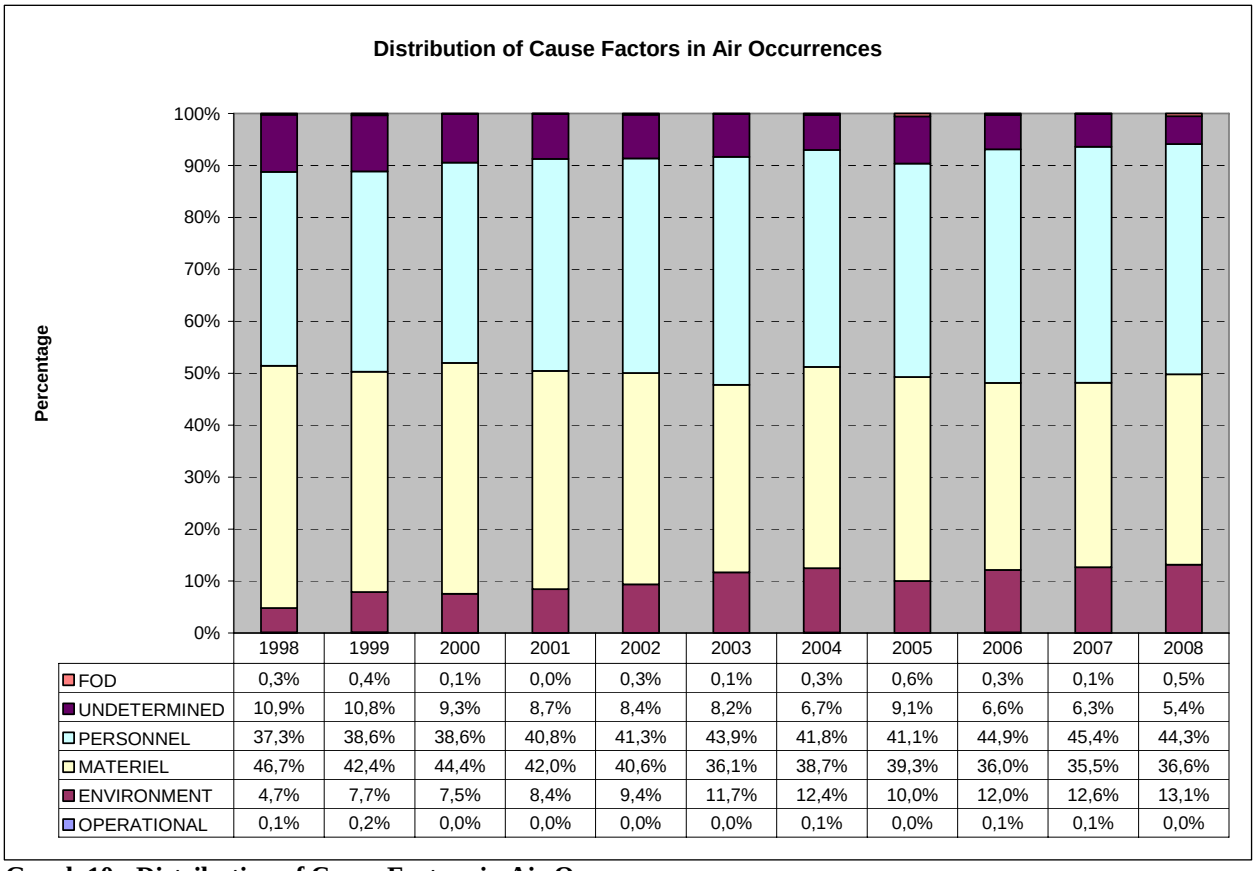
Graph 9 - ALSE Occurrence Volume and Rate

3.2.6 Cause Factor Breakdown Analysis

3.2.6.1 Air Occurrences

There has been no significant change in the distribution of cause factors in air occurrences (Graph 10). The distribution for 2008 was the following in descending order:

- Personnel – 44.3%
- Materiel – 36.6%
- Environment – 13.1%
- Undetermined – 5.4%
- Operational – 0%
- Foreign Object Damage (FOD) – 0.05%



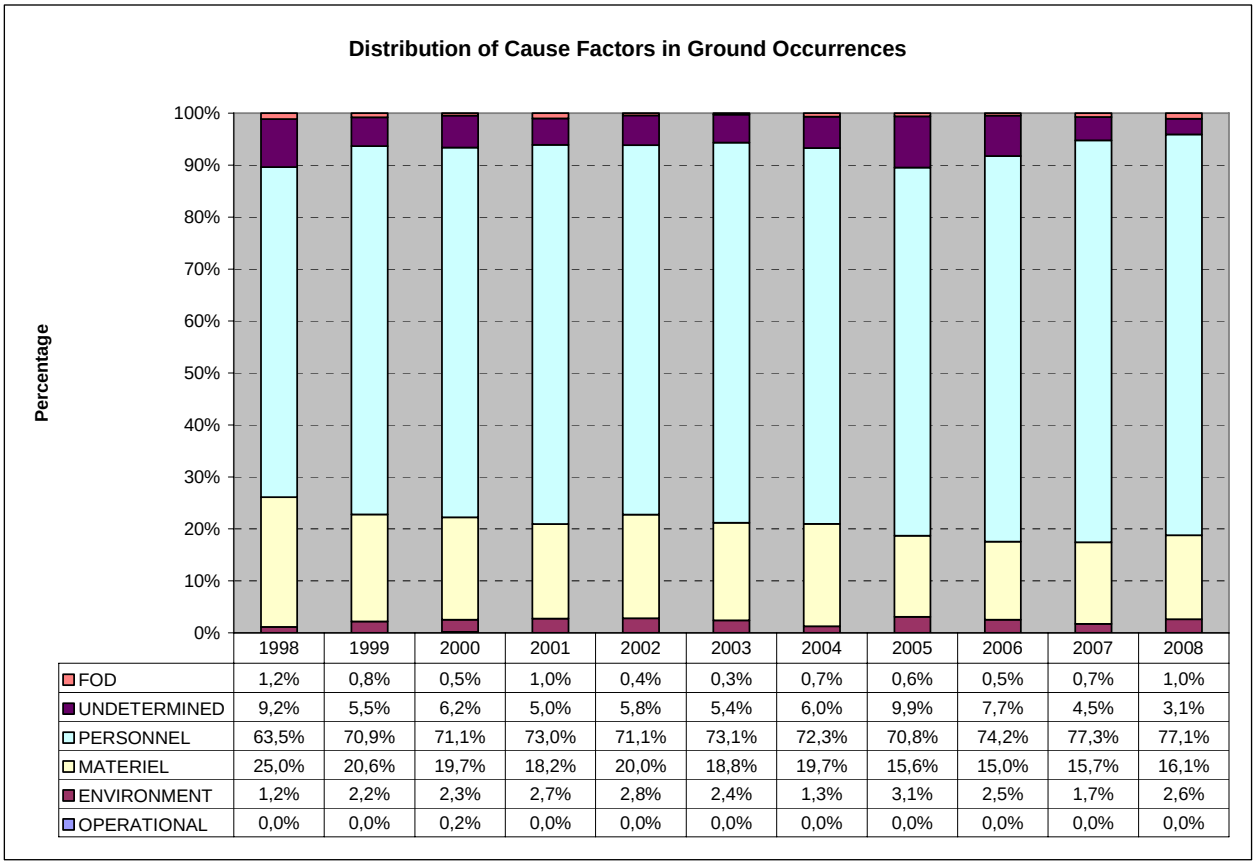
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FOD	0,3%	0,4%	0,1%	0,0%	0,3%	0,1%	0,3%	0,6%	0,3%	0,1%	0,5%
UNDETERMINED	10,9%	10,8%	9,3%	8,7%	8,4%	8,2%	6,7%	9,1%	6,6%	6,3%	5,4%
PERSONNEL	37,3%	38,6%	38,6%	40,8%	41,3%	43,9%	41,8%	41,1%	44,9%	45,4%	44,3%
MATERIEL	46,7%	42,4%	44,4%	42,0%	40,6%	36,1%	38,7%	39,3%	36,0%	35,5%	36,6%
ENVIRONMENT	4,7%	7,7%	7,5%	8,4%	9,4%	11,7%	12,4%	10,0%	12,0%	12,6%	13,1%
OPERATIONAL	0,1%	0,2%	0,0%	0,0%	0,0%	0,0%	0,1%	0,0%	0,1%	0,1%	0,0%

Graph 10 - Distribution of Cause Factors in Air Occurrences

3.2.6.2 Ground Occurrences

There has been no significant change in the distribution of cause factors in ground occurrences (Graph 11). The distribution for 2008 was the following in descending order:

- Personnel – 77.1%
- Materiel – 16.1%
- Undetermined – 3.1%
- Environment – 2.6%
- Foreign Object Damage (FOD) – 1.0%
- Operational – 0%



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FOD	1,2%	0,8%	0,5%	1,0%	0,4%	0,3%	0,7%	0,6%	0,5%	0,7%	1,0%
UNDETERMINED	9,2%	5,5%	6,2%	5,0%	5,8%	5,4%	6,0%	9,9%	7,7%	4,5%	3,1%
PERSONNEL	63,5%	70,9%	71,1%	73,0%	71,1%	73,1%	72,3%	70,8%	74,2%	77,3%	77,1%
MATERIEL	25,0%	20,6%	19,7%	18,2%	20,0%	18,8%	19,7%	15,6%	15,0%	15,7%	16,1%
ENVIRONMENT	1,2%	2,2%	2,3%	2,7%	2,8%	2,4%	1,3%	3,1%	2,5%	1,7%	2,6%
OPERATIONAL	0,0%	0,0%	0,2%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%

Graph 11 - Distribution of Cause Factors in Ground Occurrences

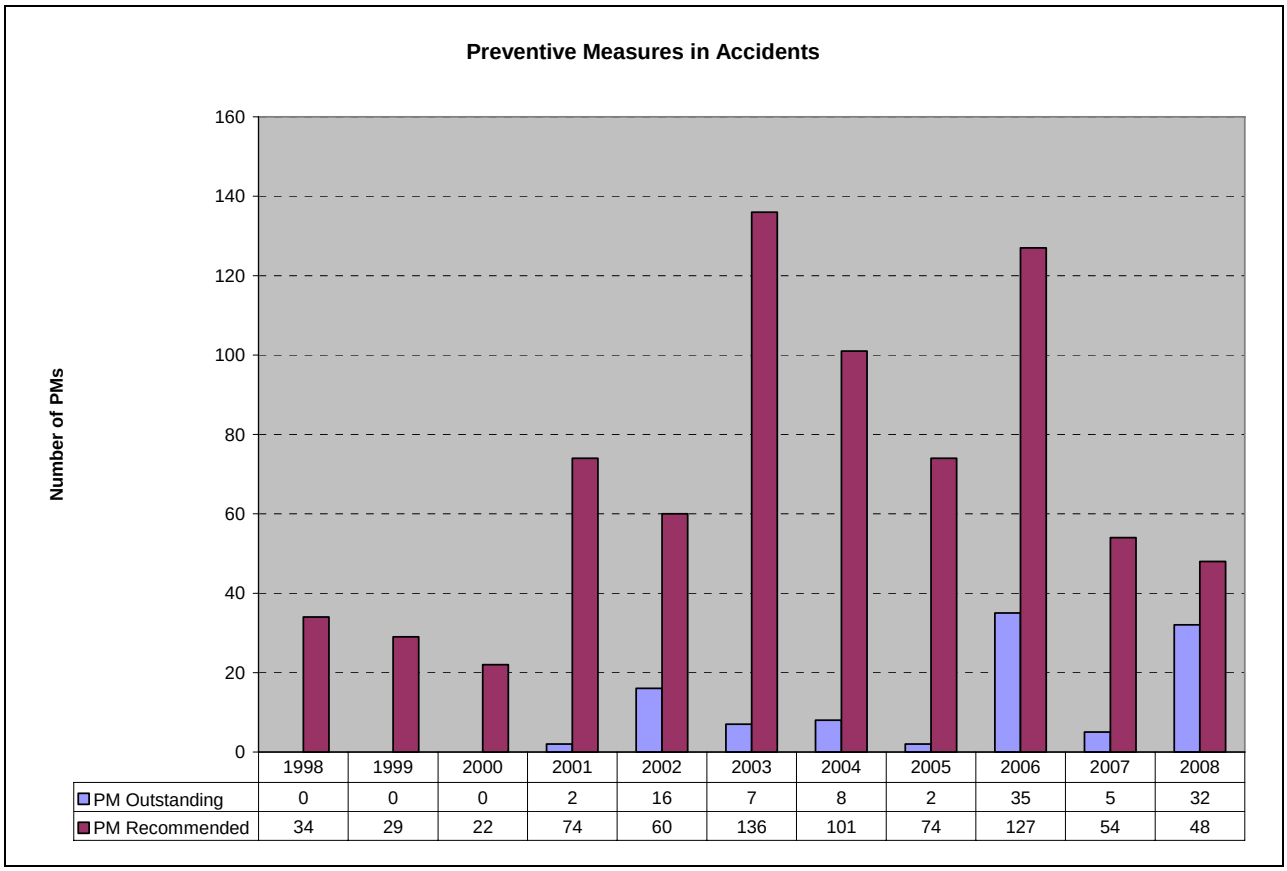
3.2.6.3 Comparison of Cause Factors for Air and Ground Occurrences

Interestingly, there is a marked difference in cause factor attribution for air and ground occurrences, most notably for 'Personnel' as a cause factor. 77.1% of ground occurrences involve a personnel cause factor, compared to only 44.3% of air occurrences. DFS will investigate the cause of this marked difference.

3.2.7 Preventive Measures

3.2.7.1 Open PMs

The development of effective Preventive Measures (PMs) by FS investigators and their timely staffing is critical to an effective prevention program. Efforts have been done in the last few years to improve the staffing of PMs in terms of time to implement and record management of measures taken or decisions made. Mitigated results have been achieved given that 214 PMs developed in 2006 or earlier are still outstanding from aircraft accident investigations (Graph 12). Graph 13 provides the same breakdown for incidents. Given the majority of PMs for incidents are staffed and closed rapidly at unit level, the relative number of outstanding PMs is much lower that accident PMs. Still, some 134 PMs are still outstanding from 2006 and earlier.

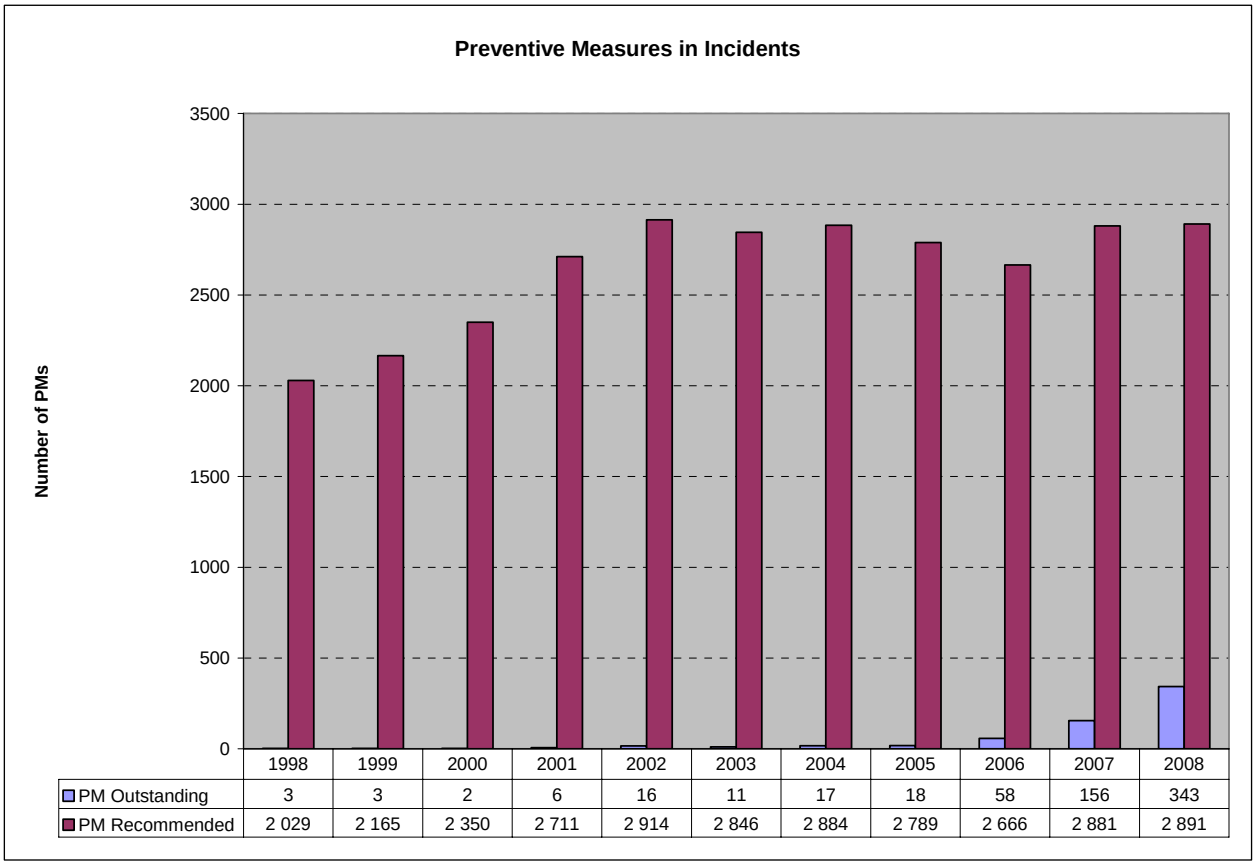


	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
PM Outstanding	0	0	0	2	16	7	8	2	35	5	32
PM Recommended	34	29	22	74	60	136	101	74	127	54	48

Graph 12 - Preventive Measures in Accidents

3.2.7.2 Preventive Measures in Incidents

Graph 13 provides the breakdown by year of outstanding incidents PMs and PMs recommended. Note that some investigations are not yet complete and further PMs may be proposed as a result of the investigation recommendations. The majority of PMs for incidents are staffed and closed at unit level, and are thus closed relatively quickly in comparison to accident PMs. Still, some 70 PMs are still outstanding from 2006 and earlier.



	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
PM Outstanding	3	3	2	6	16	11	17	18	58	156	343
PM Recommended	2 029	2 165	2 350	2 711	2 914	2 846	2 884	2 789	2 666	2 881	2 891

Graph 13 - Preventive Measures in Incidents

3.2.7.3 Occurrence and Hazard PM Tracking Working Group

DFS has mandated a Working Group to review the processes in place and make recommendations for better tracking and staffing of PMs until final disposition.

4. DEFINITIONS

4.1 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)
	CH124A	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 8 - Aircraft Families

4.2 TERMINOLOGY

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

4.2.1 Damage

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.

4.2.2 Aircraft Damage Level (ADL)

The following damage level 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.

4.2.3 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 is 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.

4.2.4 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.

4.2.5 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).

4.2.6 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.

4.2.7 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.

4.2.8 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.

4.2.9 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.

4.2.10 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.

4.2.11 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.

4.2.12 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.

4.2.13 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.