National Defence / Défense nationale

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2011
Annual Report on Flight Safety

Canada

DIRECTOR COMMENTS

This is the 7th Annual Report on Flight Safety (FS) for DND/CF. The report provides a synopsis of the investigations carried out by the Airworthiness Investigation Authority (AIA) and the activities of the Directorate of Flight Safety (DFS) for 2011. The report is divided into two parts: it describes the FS Program activities for the year, and it presents an analysis of the 2011 FS data with a comparison from previous years. In addition the report continues to refine the statistical methodologies introduced recently in order to provide a better perspective on the data presented.

FS witnessed some challenges this year due to personnel shortages at the supervisory level and the high operational tempo that resulted from our "pipeline" air force's deployment in two different theatres. While being very well supported by the chain of command, the FS Program felt the impact of increased workload due to domestic and theatre investigations and oversight of more organizations contracted to support CF flying operations. The number of reported occurrences (3149) and the rate (207.9/10000 hours) represent the status-quo when compared to the data of the previous year. Our focus needs to remain on our activities to ensure that we capture the lessons that will help us to prevent accidental loss of personnel and critical resources in this "pipeline" air force.

The 2011 DFS briefing focused on Op Tempo, crew fatigue, automation and runway incursions. The reality of flying aircraft to their maximum operating limits, in hostile theatres, and with air and ground crews taxed to their limits demands an alert and energetic Flight Safety Program. The challenge remains for supervisors at all levels to be vigilant for those circumstances that might give rise to the risk of personnel injury and aircraft damage. Key FS issues were reported back to the Chief of the Air Force for awareness and action as necessary.

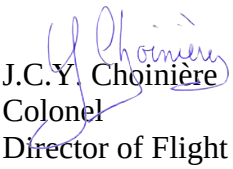
Many initiatives have been put in place to improve the FS Program. The DFS Human Factors specialist review of the Human Factors Analysis and Classification System (HFACS), used within the Flight Safety Occurrence Management System (FSOMS), resulted in recommendations that will be integrated into the A-GA-135-001/AA-001. The Minister of National Defence supported Aeronautics Act amendment will secure the appropriate investigator powers to conduct aviation safety investigations, particularly when civilians are involved. The Airworthiness Investigation Manual, which was published in February 2011, prompted follow-on activities that support improvements to the FS Program, such as the consolidation of the FS training course, AIA policy with respect to Aircraft Recording Devices, and the requirement for the AIA to delegate certain authorities to Wing FS Officers. Finally, amendments to the A-GA-135-001/AA-001 covered changes such as the FS strategic business model, clarification of the Air Cadet command structure, clarification of Good Show and For Professionalism staffing procedures, adjustment of the CF aircraft definition, amendment of Hazard Report Form DND 2484, and adjustment of the Investigation Class Table.

In the last year, four points were observed from an analysis of the 2011 FS data. First, the CF and the Air Cadet Glider Program have seen a higher level of personnel injury and damage to aircraft in recent years. The Flight Safety team is exploring ways of identifying the associated hazards and addressing them to reduce these numbers. Second, the number of near mid-air collisions in training areas has increased, despite efforts to reduce them. There will be no easy solution for this complex problem, but a concerted effort by all is required before there is another accident. Third, the data for the 2011 report was hindered because more than 16% of reports

were not completed on time. The release of preventive measures and their timely staffing by the chain of command is critical to an effective prevention program. DFS will endeavour to monitor this problem closely in the future, determine what is causing the delays and take steps to streamline our reporting processes. Finally, our system for classifying human factors, HFACS, has encountered roadblocks. As reported previously, investigators have had difficulty assigning consistent cause factors for similar circumstances and hence, the data derived is inaccurate. The DFS human factors specialist has reviewed the classification system and made recommendations to DFS.

DFS and the rest of the FS is not without its challenges! Although the RCAF's Flight Safety Program has been a world leader in the field for over 65 years, we are continually fine-tuning it to ensure that the men and women of all environments who either conduct or support air operations do so within an acceptable level of risk. We all have a say – Flight Safety is everybody's business!

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



J.C.Y. Choinière
Colonel
Director of Flight Safety

EXECUTIVE SUMMARY

This report provides a synopsis of the activities carried out in 2011 by the Airworthiness Investigative Authority (AIA) and the Directorate of Flight Safety (DFS) in relation to the Flight Safety (FS) Program of the Canadian Forces. 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 11 investigations and closed 15. The investigations tasked by DFS were for eight accidents (three category 'A', one category 'B', and four category 'C'), and one incident (one category 'D'). These figures include two Air Cadet (categorized non-CF) investigations for two accidents (one category 'B' and one category 'C').

Aeronautics Act Amendment. The AIA obtained the Minister of National Defence's support to advance a Department of National Defence lead amendment to the *Aeronautics Act.* The amendment has for goal the securing of the appropriate powers for investigators to conduct investigations concerning aviation safety, particularly when civilians are involved in the occurrences. As of March 2012, the CF/DND internal administration for this initiative was completed and follow on steps should result in the projected introduction of the proposed amendment in the fall 2012 session of Parliament.

Airworthiness Investigation Manual. The A-GA-135-003/AG-00 *Airworthiness Investigation Manual* (AIM) was published in February 2010 with the procedures and processes outlined in the manual coming into effect 15 April 2010. Recent changes in the FS program and policy, notably the consolidation of FS training course, the AIA's policy with respect to Aircraft Recording Devices (ARDs) and the requirement for the AIA to delegate certain authorities to WFSOs have precipitated the requirement to amend this publication in these specific areas. The projected amendment completion is fall/winter 2012-13. The AIM is available on-line via the DFS website under Publications at http://www.airforce.forces.gc.ca/dfs-dsv/index-eng.asp.

Amendments to A-GA 135-001/AA-001. Amendment #4 of the A-GA 135-001/AA-001 *Flight Safety for the Canadian Forces* was released on 01 Apr 2011. The amendment covers changes relevant to the simplification of the FS strategic business model, the clarification of Air Cadet command structure, clarification of Good Show and For Pro staffing procedures, adjustment of the CF Aircraft definition, amendment of Hazard Report Form DND 2484, clarification of quarantine documentation and authority to lift quarantine, determination of For Tracking Purposes Only occurrence closure, adjustment of the Investigation Class Table. Amendment #5 of the A-GA 135-001/AA-001 was in draft form at the end of the year and is due for release in April 2012.

CVR/FDR Working Group. There were no meeting held during the period. The implementation policy remains focused at tackling one fleet per year for the next 10 years based on fleet prioritizations. A Small Capital Project was staffed, approved and funded to install an Alternate Means of Compliance CVR/FDR system on the CT114.

FLIGHT SAFETY PROGRAM

Promotion. DFS presented 41 annual briefings (33 English and eight French) at 26 locations across Canada as well as the Canadian contingent at Geilenkirchen, CDLS (London) and SHAPE HQ Belgium, and reached approximately 7500 personnel. DFS met with over 75 Commanding Officers and their Squadron Warrant Officers and visited eight air traffic control towers. DFS published three issues of *Flight Comment* magazine, one issue of *On Target* magazine, which focussed on new technologies, three issues of the electronic FS newsletter *Debriefing* and one FS Flash message. A total of 29 FS award submissions for individuals or groups were considered and resulted in the granting of two Good Show and 18 For Professionalism awards and nine recommendations for Commanders Commendations.

Surveys. DFS conducted five FS surveys with contracted organizations: Cascade Aerospace Ltd in Abbotsford, BC; Kelowna Flightcraft Limited in Kelowna, BC; Bell Helicopter represented by Alpine Aerotech Limited in Kelowna, BC; Orenda Aerospace Corporation in Mississauga, ON; and Vector Aerospace in Richmond, BC. The FS staff at the division level conducted surveys of 8, 9, 12, 14, 16, 17 and 19 Wings as well as 443 Sqn and 3CFFTS. A FS Staff Assistance Visit (SAV) to 1 Wing was completed. With over 50 visits to Sqns, supporting units, and contracted service providers, the FS staff was able to provide the chain of command (CoC) with effective feedback on the stressors affecting each unit, along with specific recommendations for improving FS prevention programs with the aim of reducing risk and FS accidents or incidents.

Training. A total of five Basic Flight Safety Courses and two Advanced Flight Safety Courses were conducted by 1 Cdn Air Div FS staff. They qualified 187 personnel, including Air Cadet staff members, civilian contracted service providers, Army personnel and DND firefighters. The Basic and Advanced Flight Safety courses have now been combined into a single Flight Safety Course. A trial course was conducted at the end of the year. Staffing is on-going for the approval of a new Training Standard and associated Training Plan.

STATISTICS AND DATA ANALYSIS

Flying Hours and Reporting. Compared to 2010, the number of hours flown in the CF has increased by 1.9%, accompanied by a 4.2% reduction to the Air Cadet Glider Program (ACGP), and a 49% reduction of Unmanned Aerial Vehicles (UAV) due to a cessation of operations. Personnel reported 3,149 occurrences, of which 56.27% were classified as Air occurrences. When compared to last year, the rate remains virtually unchanged (207.87 compared to 208.27 in 2010).

Occurrence Breakdown. The CF had a less than favourable FS record for 2011. Major and minor injuries have increased, (one fatal, six serious, and 49 minor), a total of two aircraft were destroyed (one CT155 and one CH147 Chinook). The air accident rate for the CF has increased for the third year in a row to 0.96. This was attributable to three category 'A' accidents (one CT155 Hawk, one CH147 Chinook and one fatality) and 10 category 'C' accidents (two CH146, one CH139, one CC138 and six Pers injuries). The major injuries are predominantly associated with SAR Tech operations. The serious injuries rate is above the 10- year mean and should be investigated further. The major injuries rate is greater than the 10-year average rate of 0.66, and

marks the fourth consecutive year above the mean. Although statistical data for the Air Cadet program show a decrease from last year's high (2.53 vs. 3.03) it remains above the previous 5-year mean (2.17) which is indicative of a negative tendency. The UAV accident rate was 0.0 and reportable UAV operations have now ceased.

Personnel Cause Factor. The DFS Human Factors specialist reviewed of the Human Factors Analysis and Classification System (HFACS) for assigning human errors in the Flight Safety Occurrence Management System (FSOMS). The resulting observations and recommendations which will also include amended definitions for the assignment of specific factors were briefed to DFS.

Cause Factor Analysis. An important part of the DFS prevention activities surround the data analysis and comparison to previous years. Cause Factor analysis is based on data from completed reports only as draft reports are subject to change. Preventive measures and their timely staffing and implementation by the chain of command are critical to an effective prevention program. Overdue occurrence reports have a detrimental effect on our ability to analyze and trend cause factors and the distribution of PM information. This year is particularly critical due to the amount that were overdue (509 of the 3149) at the time of the report (247 Air and 262 Ground)

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2011 FLIGHT SAFETY ANNUAL REPORT

1. AIRWORTHINESS PROGRAM

1.1 AERONAUTICS ACT UPDATE (2011-2012)

The AIA obtained the MND's support to advance a DND's amendment of the *Aeronautics Act.* The amendment will secure appropriate powers to enable investigators to fully investigate aviation safety occurrences, particularly when civilians are involved. As of March 2012, the internal DND administration for this initiative was completed and follow-on steps should result in the projected introduction of the proposed amendment in the fall 2012 session of Parliament.

1.2 AIRWORTHINESS INVESTIGATIVE MANUAL

The A-GA-135-003/AG-00 *Airworthiness Investigation Manual* (AIM) was published in February 2010 with the procedures and processes outlined in the manual coming into effect 15 April 2010. Recent changes in the FS program and policy, notably the consolidation of FS training course, the AIA's policy with respect to Aircraft Recording Devices (ARDs) and the requirement for the AIA to delegate certain authorities to WFSOs have precipitated the requirement to amend this publication in these specific areas. The projected amendment completion of this publication is fall/winter 2012-13. The AIM is available on-line via the DFS website under Publications at http://www.airforce.forces.gc.ca/dfs-dsv/index-eng.asp.

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 five FS surveys at contracted service provider sites (Cascade Aerospace Ltd in Abbotsford, BC, Kelowna Flightcraft Limited in Kelowna, BC, Bell Helicopter represented by Alpine Aerotech Limited in Kelowna, BC, Orenda Aerospace Corporation in Mississauga, ON, and Vector Aerospace in Richmond, BC) as part of the DFS's contracted service provider visit program. These surveys are part of a continuous improvement effort and provide a platform from which the safety culture at each organizations can be sampled regularly. Original visits, as was the case at Alpine Aerotech and Vector Aerospace served to establish a baseline for future references. While observations were made at each locations, a desire to support the FS Program was evident. Follow-up visits to the remaining service providers identified above allowed an assessment of the evolution of each of their Flight Safety Program. All have shown positive trends since our previous visits. The FS staff at the division level conducted surveys of 8, 9, 12, 14, 16, 17 and 19 Wings as well as 443 Sqn and 3CFFTS. A FS SAV to 1 Wing was completed. With over 50 visits to Sqns, supporting units, and contracted service providers, the FS staff was able to provide the CoC with effective feedback on the stressors affecting each unit, along with specific recommendations for improving FS prevention programs with the aim of reducing risk and FS accidents and incidents.

1.4 WORKING GROUPS

1.4.1 CVR/FDR Working Group

There was no meeting held during the period. As identified in the 2009 AAB, the implementation policy remains focused at tackling one fleet per year for the next 10 years based on fleet prioritizations. A CVR/FDR Implementation Strategy, which is a roadmap to meet the CVR/FDR Policy requirements, was staffed to CAF. D Air Contracted Force Generation (CFG) continues to issue Requests for Proposals (RFPs) or Contract Change Orders to contract for CVR/FDR services; however, the affected contractors have not been as responsive as desired. A Small Capital Project (SCP) was staffed, approved and funded to install an Alternate Means of Compliance CVR/FDR system on the CT114.

1.4.2 FSOMS Working Group

Although no FSOMS Working Group (WG) was held in 2011, action items identified in the 6th FSOMS WG are ongoing. The Safety Information Management System (SIMS) project was initiated and should produce a new version of FSOMS (FSIMS) within 18 months. The FSOMS Periodic all wing level report was introduced and has since been modified with user comments to refine the frequency and data output. The ability to enter and search Safety of Flight Compromise Level (SFCL) data has been added to V3.0.6.

1.5 INVESTIGATIONS

1.5.1 Investigation Summary

During the calendar year, the AIA initiated eight investigations and closed 15. The investigations tasked by DFS were for eight accidents (three category 'A', one category 'B', and four category 'C'). These figures include two Air Cadet (categorized non-CF) investigations for two accidents (one category 'B' and one category 'C').

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
CLASS I INVESTIGATIONS						
1	15 May 11	A	Destroyed	Minor	Hawk	Engine power loss
2	27 Oct 11	A	Nil	Fatality	SAR Tech	Attempted rescue at sea
CLASS II INVESTIGATIONS						
3	23 Feb 11	C	Serious	Nil	Griffon	Hard Landing in dustball
4	15 Apr 11	A	Destroyed	Serious	Chinook	Roll-over on landing
5	19 Apr 11	C	Nil	Serious	SAR Tech	Hard parachute landing
6	17 Jun 11	C	Serious	Nil	Griffon	Near CFIT / Overtorque

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
7	18 Jun 11	C	Minor	Serious	Glider	Hard landing
8	25 Jul 11	B	Very Serious	Minor	Belanca Scout	Nose-over on landing

Table 1 - List of 2011 AIA Initiated Investigations

1.5.2 Investigation Details

1.5.2.1 23 Feb 11, CH146476, Accident, Category 'C', Yuma, AZ

The Griffon was scheduled as part of a two-ship close combat attack (CCA) training mission which included the insertion / extraction of a joint tactical air controller (JTAC). During the extraction, while attempting their second approach to a spot 100 feet south of an observation post and fence, a dustball formed at 30 to 40 feet AGL. By 20 feet the flying pilot lost all references. The non-flying pilot and aircraft captain (AC) lost his forward references, transitioned to other ground features but did not take control. During the approach, the helicopter yawed 25 degrees and drifted forward and laterally right approximately 120 feet, coming to within 20 feet of the fence. The aircraft touched with the rear part of the left skid, bounced, pitched down and rolled left scraping the front part of the left skid on the ground.

Under external pressure and time constraints, aircrew were authorized to fly a CCA mission, which included dust landings, in low illumination conditions. The AC, under similar external pressures, elected to accept the mission. Although having conducted multiple approaches that evening to the same area that resulted in overshoots, during the final incident approach, the crew still elected to conduct the approach. The flying pilot did not fly the prescribed procedure as dictated and had difficultly judging height and closure rate.

Safety recommendations included amendments to CH146 NVG operations to unprepared surfaces in desert environments, in low illumination and in degraded visual environments. It was also recommended to implement the domestic use of a Mission Authorization and Launch Authority process.

Other recommendations included modifying the CH146 FDR to include the recording of GPS based latitude, longitude and groundspeed, along with radar altimeter channels to accurately recreate the flight-path of an incident/accident aircraft.

1.5.2.2 19 Apr 11, CH146489, Accident, Category 'C', BFC Bagotville, QC

The Griffon was being used to conduct SAR Tech freefall daylight parachute jump training currency. The drop zone was the mid-point of the abandoned runway 06/24 at Bagotville. The surface winds were westerly at 14 knots gusting between 19 and 21 knots. The occurrence SAR Tech was the third to jump but because of a greater free-fall time, the first to land. The SAR Tech was injured after landing on the hard runway surface. The investigation is ongoing.

1.5.2.3 15 May 11, CH147205, Accident, Category 'A', Kandahar province, Afghanistan

Chinook CH147205 was conducting a night insertion using NVGs as part of a deliberate operation. The insertion was to be conducted simultaneously by two Chinook aircraft at an unprepared Helicopter Landing Site (HLS). The HLS was situated on a the north shore of a dried river bed. The lead Chinook was the first to touchdown and, in doing so, generated a large dustball. The crew of the accident Chinook was monitoring the dustball generated by the lead Chinook but assessed that it did not jeopardize their approach and landing. The accident Chinook was flared at 20 feet AGL as per normal procedures for landing, using NVG-HUD information. At this point in the landing process, both pilots had lost visual ground references and the flight controls were frozen in place by the flying pilot in preparation for the touchdown. On touchdown, which was characterized as a little more firm than normal, the pilots immediately felt an unusual aircraft motion to the right. The aircraft captain instantly took control in an attempt to stabilize and level the aircraft, however without success. When it was realized that the aircraft would roll over, the engines were shutdown by retarding the Engine Control Levers to the "STOP" position.

There were five crew members and twenty six passengers onboard the aircraft, including a civilian news reporter. None of the twenty six passengers were using seatbelts. There was one serious injury, eight minor injuries, and the remaining personnel suffered only very minor injury or were uninjured at all. The investigation is ongoing.

1.5.2.4 10 Jun 11, CT155201, Accident, Category 'A', Near Cold Lake, AB

A crew of two qualified instructors was conducting an instructor upgrade sortie and wingman syllabus mission in clear weather in a CT155 Hawk aircraft when the pilots noticed a loud bang followed by increasing turbine gas temperature. The aircraft throttle was positioned to a medium power setting to commence a shallow climb through 10,000' above ground level. The wingman reported increasing amounts of smoke coming from the lead aircraft and the aircrew felt increasing engine vibrations. The pilots responded to these indications by shutting down the aircraft's engine. Later, the pilots determined they would not be able to glide to either Cold Lake runway and attempted to restart the engine to gain altitude. During the restart, the wingman reported flames coming from the lead aircraft. The pilots stopped the start and continued to glide towards Cold Lake. Unable to reach any runway, they carried out a controlled ejection initiated by the rear seat pilot. The aircraft crashed and was destroyed. The pilots received minor injuries.

The post-crash field investigation revealed a missing low pressure turbine (LPT) blade from Module 8 in the engine, which is similar to LPT blade failures in four previous CF Hawk aircraft occurrences. The engine and other aircraft components were sent to the Quality Engineering Test Establishment and the National Research Council for further analysis.

The investigation is focussing on the failure of the LPT blade, crew emergency procedures and aviation life support equipment deficiencies.

1.5.2.5 17 Jun 11, CH146491, Near CFIT, Category 'C', Cobourg, ON

During a night boat hoist training mission with a Canadian Coast Guard vessel, the aircraft captain (AC) who was also the flying pilot (FP) of the CH146 Griffon lost situational awareness while trying to position the helicopter in the rest position. After having completed the over water transition down (OWTDN) approach, the AC seated in the left seat, relinquished control of the helicopter to the First Officer (FO) who was seated in the right seat and the FP for the remainder of the sequence. Both pilots were wearing and using night vision goggles. During the approach from the Minimum Descent Altitude (MDA) of the OWTDN to the target altitude of 25 feet above water level, the

aircraft was placed in a descending and decelerating attitude. The FP was attempting to position the helicopter in the rest position near the vessel. The aircraft descended to approximately 30 to 40 feet and then started to drift back and up, reaching 70 feet. As the FP attempted to descend back down and establish the aircraft in the rest position, he lost situational awareness and started pulling collective to arrest the descent. As the low rotor tone was heard the AC noticed the aircraft descending through 30' and saw the mast torque at 110%. An overshoot was initiated and the aircraft returned to base.

The ongoing investigation is focussing on crew coordination and training procedures

1.5.2.6 18 Jun 11, C-FYLP, Accident, Category 'C', Markham, ON

Two Cadet Instructor Cadre Reserve Officers were conducting glider instructor refresher training when they experienced a hard landing. Both pilots egressed the aircraft under their own power and were taken to the local hospital for examination, where it was determined that the front seat pilot had sustained serious injuries.

The on-going investigation is focussing on the seat cushion fitting.

1.5.2.7 25 Jul 11, Bellanca Scout C-GSSD, Accident Category 'B', Gimli, MB

The glider tow plane pilot landed the aircraft further down the grass landing lane than on any previous landing that afternoon. As the wheels contacted the ground the pilot realized that he was approaching his ideal stopping point too quickly. He applied the brakes abruptly and aggressively to avoid rolling beyond this point which slowed the aircraft and forced the tail to rise from the ground. The pilot released the brakes and ensured that the control stick was in the full aft position. Knowing that the tail wheel had not yet settled back onto the ground, the pilot was concerned that the aircraft might become unstable and re-applied the brakes hoping to stabilize the aircraft. As the aircraft came to a stop tail resumed its upward movement. The aircraft slowly nosed over and came to rest in an inverted position. The pilot egressed the aircraft with very minor injuries and was taken to the local medical facility.

The investigation concluded that aggressive braking in combination with less than full aft back pressure on the control stick in a zero wind condition led to the tail rise of the aircraft and initiated the accident sequence. This second application of the brakes caused the aircraft to nose over.

Preventative measures taken consisted of briefing and providing additional ground school training to the pilot. Further recommendations included amendments to the local flying orders in order to clarify the purpose and location of all cones used on the Gimli airfield.

1.5.2.8 27 Oct 11, CC130323, Accident, Category 'A', Near Igloolik, NU

A Hercules aircraft from 424 Squadron Trenton was tasked to fly to the Arctic community of Igloolik to assist two people stranded in pack-ice in their small open boat. The crew of the aircraft believed the men were dehydrated and hypothermic and a decision was made to do a rescue parachute jump to the raft to provide medical assistance. The seas were 6-12 feet high with some ice present. The winds were between 25 to35 knots and the air temperature was – 8ºC.

One SAR technician was able to swim to the raft where he provided assistance to the men until recovery by CH149 helicopter, approximately four hours later. The second SAR technician swam until he realized he could not close the distance to the raft. He deployed his personal one man life raft, stowed his rescue gear and bailed his raft until recovery by the CH149 helicopter. The SAR technician team leader landed furthest from the raft. Five hours after the jump, the SAR technician was found unresponsive, floating in the sea with the life preserver inflated. The SAR technician was wearing a dry suit that was not optimized for use on the CC130. Of particular note, the tether designed to hold his one man raft to his life preserver had separated at the threads and this life raft was missing.

The investigation is focussing on SAR Technician personal life support equipment and the regulations governing rescue activities.

1.5.2.9 14 Feb 12, CH146453, Accident, Category 'B', Yellowknife, NWT

During exercise ARCTIC RAM, the Griffon struck high-tension power lines while conducting a low-level night flight to familiarize the crews with the intended area of operations. The upper wire strike protection system functioned properly but the aircraft suffered considerable damage to the left front windshield, top window and adjacent upper fuselage section. Electrical burn marks were also found on the fuselage and tail boom. The crew were uninjured and were able to land safely at the nearby Yellowknife airport. The Investigation is on-going.

1.5.2.10 21 Feb 12, CC130342, Accident Category 'B', Key West, FL

The accident occurred during a touch and go at Naval Air Station Key West. Just prior to the aircraft becoming airborne, the aircraft loadmaster, seated in the rear of the cargo compartment, heard an electrical buzzing sound and observed an orange jet-like flame shoot across the cargo ramp from left to right at floor level, followed immediately by an expanding orange fireball. The loadmaster proceeded forward and alerted the crew to the fire while calling for the takeoff to be aborted.

Concurrently, the aircraft had just become airborne and reached 10 feet above the runway. The pilot landed straight ahead and aggressively stopped the aircraft. Once the engines were shut down, all nine crewmembers quickly egressed and moved upwind of the aircraft. Crash, fire and rescue services responded and quickly extinguished the fire. The aircraft was extensively damaged and one crewmember received a minor injury during egress.

The investigation team identified that a stainless steel braided flexible hydraulic line associated with the auxiliary hydraulic system pump was breached where it routed next to an electrical power cable. The ongoing investigation is focussed on the maintenance history of the auxiliary hydraulic system.

1.5.3 Investigation Report Status

1.5.3.1 Table 2 outlines the status of ongoing investigations as of 31 Dec 2011. Definitions for SR, ESR and FSIR can be found in terminology article 5.2.

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
30 Apr 09	CH146000	CH146 limit exceedances	ESR being drafted
08 May 09	SAR Tech	SAR tech fouled parachute	Draft for comment released
06 Jul 09	CH146434	Crashed on departure in brownout	FSIR review
27 Jul 09	CH149910	Main Gear Box casing crack	Draft for comment
16 Jul 10	Heron 255	UAV hit telephone pole on final and crashed	ESR being drafted

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
23 Jul 10	CF118738	Airshow demonstration 'High Alpha' pass with engine failure	FTI published 27 Jul 11 Draft for comment in progress
05 Aug 10	CH147202	Aircraft shootdown in theatre	FSIR final being drafted
18 Nov 10	CF118789	Crash on approach	Draft for comments
23 Feb 11	CH146476	Hard landing in dust ball	Draft for comments
19 Apr 11	CH146489	SAR Tech hard landing	Drafting ESR
15 May 11	CH147205	Hard landing and rollover in brownout	Drafting ESR
10 Jun 11	CT155201	Engine failure followed by ejection	Draft for comments
17 Jun 11	CH146491	Overtorque during night boat hoist	Drafting ESR
18 Jun 11	C-FYLP	Injury on landing	Drafting ESR
25 Jul 11	C-GSSD	Scout nose-over	Drafting ESR
27 Oct 11	SAR Tech	SAR Tech fatality during Arctic SAR mission	Draft for comments

Table 2 - Ongoing Investigation Report Status

1.5.3.2 Table 3 outlines the investigations that were closed during 2011.

ACCIDENT DATE	AIRCRAFT	DESCRIPTION	INVESTIGATION CLOSURE DATE
30 Aug 07	CH149903	Main rotor head damaged during maintenance	SR entered in FSOMS 27 Oct 11
31 Oct 07	CH149902	Extensive wear damage on swash plate found on daily inspection	SR entered in FSOMS 28 Mar 11
19 Jan 08	CH146488	Near rollover and over torque	Epilogue posted 06 Jun 11
06 Sep 08	C-GQYY	Premature rope release	Epilogue posted 07 Oct 11
05 Aug 09	C-GCSK	Glider hit trees on final approach	Epilogue posted 26 sep 11
13 Aug 09	CT156101	Near collision	Epilogue posted 05 Dec 11
06 Sep 09	C-FNWO	Glider hard landing	FSIR posted 22 Dec 11
17 Nov 09	CF188925	Training round lands app 50 feet from ground personnel	FSIR posted 01 Mar 2012

26 Nov 09	CC115465	Structural damage while refuelling	FSIR posted 07 Apr 2011
14 Jun 10	CH124416	Crane encroaching final approach to runway	Epilogue posted 03 Mar 2011
01 Aug 10	CH146425	Stinger strike on final to forward arming and refuelling point	FSIR posted 09 Sep 11
08 Nov 10	C-FMFR	Gear collapse on landing	Epilogue posted 30 Aug 11
18 Apr 08	CT155215	Engine failure	Epilogue posted 11 Jan 12

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. 41 annual briefings were presented (33 English and eight French) at 26 locations across Canada and included the Canadian Contingent at Geilenkirchen, CDLS (London) and SHAPE HQ Belgium, and reached approximately 7500 personnel. DFS met with over 75 Commanding Officers and their Squadron Warrant Officers as well as visited eight air traffic control towers. DFS published three issues of Flight Comment magazine; one issue of On Target magazine, which focussed on new technologies; and three issues of the electronic FS newsletter Debriefing. There was one FS Flash message released during 2011.

2.2 AWARDS

A total of 29 FS award submissions for individuals or groups were considered resulting in the granting of two Good Show and 18 For Professionalism awards and nine recommendations for Commanders Commendations. When compared to the previous reporting period, although there were four fewer award nominations submitted, the total number of awards granted increased by four.

2.3 TRAINING

A total of five Basic Flight Safety Courses were conducted by 1 Cdn Air Div FS staff. They qualified 149 personnel, including Air Cadet staff members, civilian contracted service providers, Army personnel and DND firefighters. They also conducted two Advanced Flight Safety Course serials that qualified 38 personnel. The Basic and Advanced Flight Safety courses have now been combined into a single Flight Safety Course. The Specialty Specification Codes will be amended to enable the tracking of these qualifications.

3. STATISTICS AND TREND ANALYSIS

3.1 GENERAL

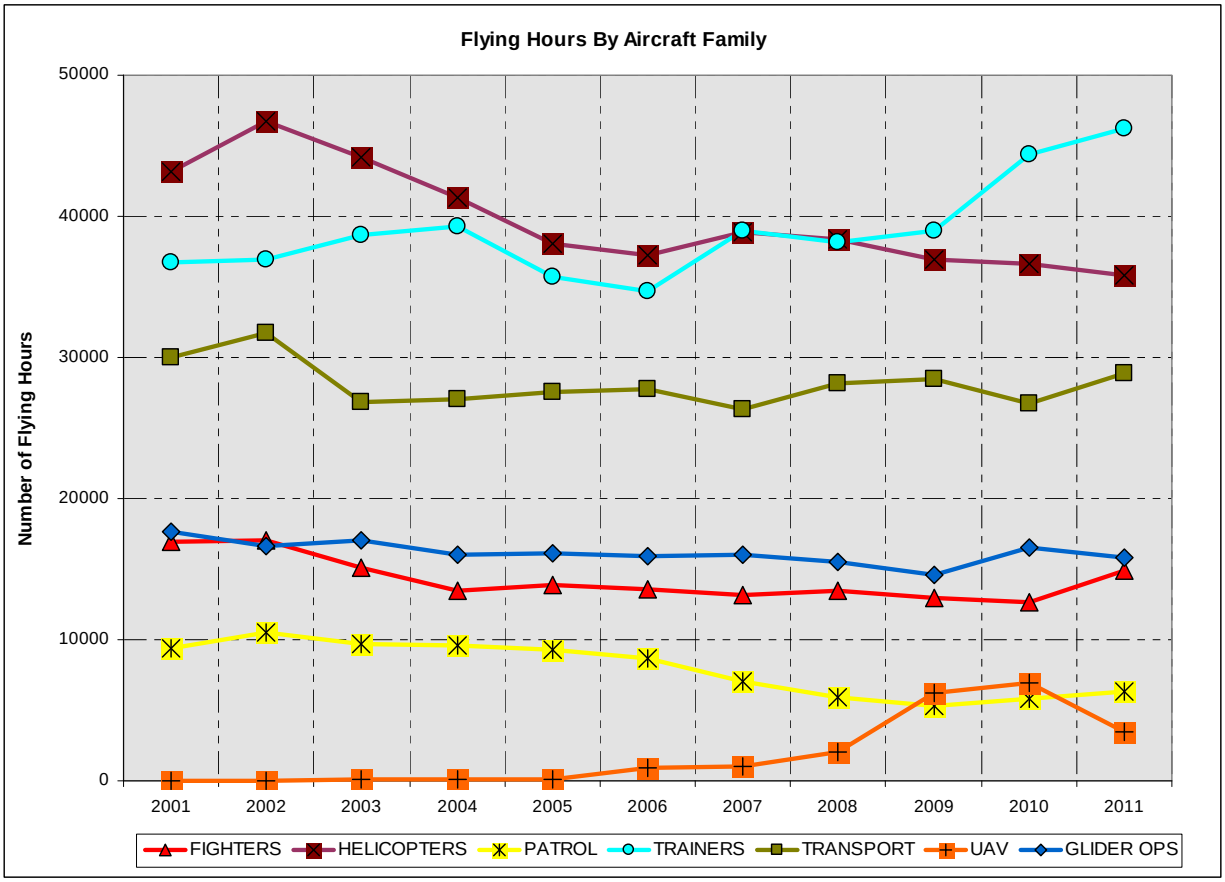
Rates are calculated per 10,000 flying hours, except for cause factors and HFACS data, which is reported per 1000 occurrences. Data is classified according to the level of concern and randomness. The colour code shown below is derived from the difference between the 2011 value and the 10-year mean (unless otherwise stated), in multiples of the standard deviation (D). 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 is assessed as requiring detailed examination. If D is between 2 and 3 ($2<D\leq3$), it is colour-coded orange (Caution), and is assessed as requiring some examination. If D is between 1 and 2 ($1<D\leq2$), it is colour-coded yellow (Note) and is assessed as requiring 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.

Improvement	Normal	Note	Caution	Warning

3.2 FLYING HOURS

3.2.1 Flying Hours by Aircraft Family and Type

The overall flying hours indicate an increase from 149,613 to 151,485 compared to the previous year (a 1.25% increase). This was due mainly to an increase in some trainer hours (CT102, CT156), the fighters (CF18) and the Transport fleets (decrease of CC130 hours and increase of CC130J and CC 177 hours) which were offset by a reduction in the UAV hours. Graph 1 shows the flying hours by aircraft family. Table 4 further subdivides the hours by aircraft type.



Graph 1 - Flying Hours by Aircraft Family

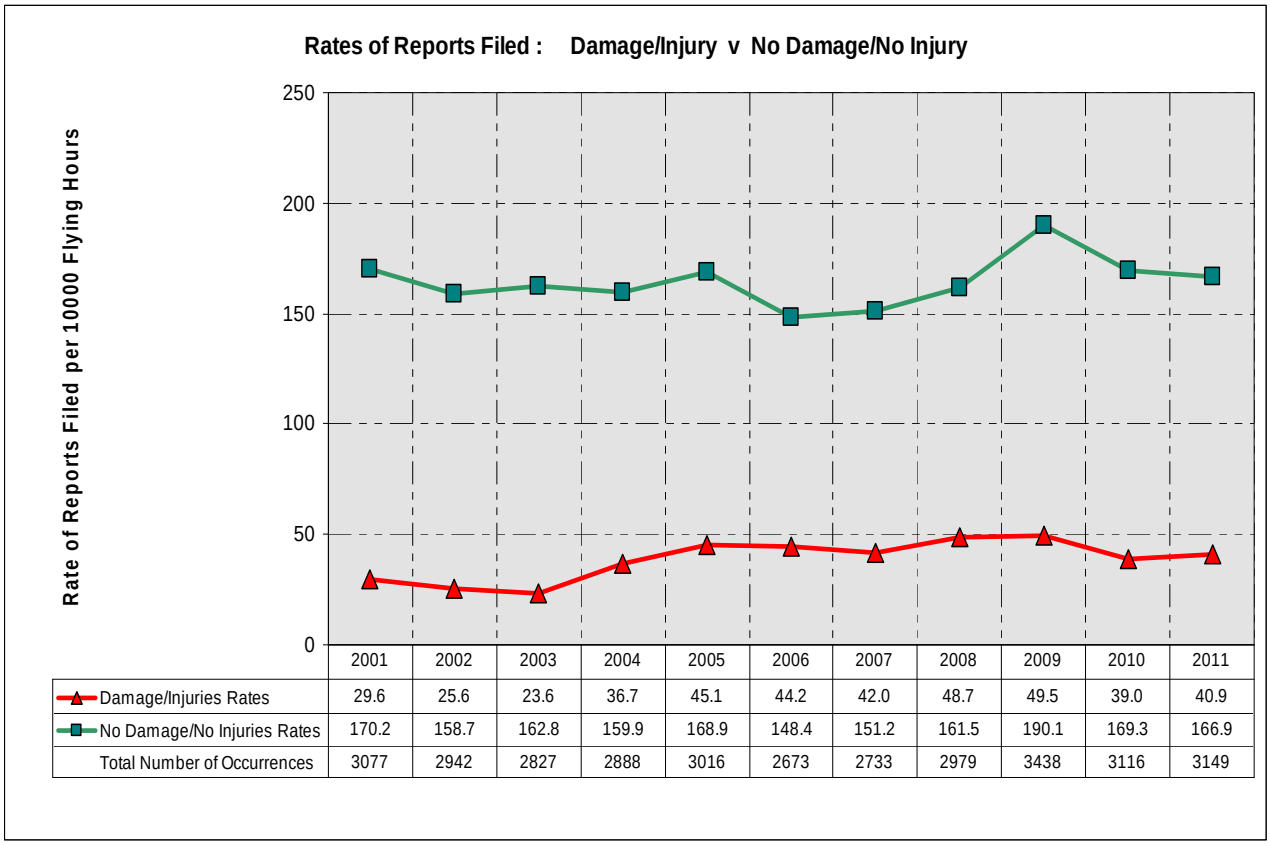
FLYING HOURS	01	02	03	04	05	06	07	08	09	10	11
FIGHTERS	**16967**	**17004**	**15126**	**13476**	**13836**	**13546**	**13142**	**13497**	**12980**	**12699**	**14885**
CF116	116	68	18	0	0	0	0	0	0	0	0
CF188	16851	16936	15108	13476	13836	13546	13142	13497	12980	12699	14885
HELICOPTERS	**43197**	**46725**	**44212**	**41317**	**38100**	**37270**	**38885**	**38406**	**36957**	**36608**	**35814**
CH113	5366	4040	1626	464		0	0	0	0	0	0
CH124	10576	10546	8226	8487	6857	6944	7628	7984	7830	7771	8169
CH139	6527	6666	6070	6371	5024	4613	4852	5684	1863	1834	2241
CH146	20489	22277	23384	21426	21632	21150	21465	19661	20332	19100	18469
CH147	0	0	0	0	0	0	0	4	2058	2743	1605
CH149	239	3196	4906	4568	4586	4563	4939	5073	4875	5159	5330
PATROL	**9418**	**10554**	**9684**	**9642**	**9324**	**8704**	**7012**	**5952**	**5324**	**5832**	**6369**
CP140	9418	10554	9684	9642	9324	8704	7012	5952	5324	5832	6369
TRAINERS	**36783**	**36973**	**38657**	**39313**	**35745**	**34741**	**39023**	**38210**	**38997**	**44361**	**46253**
CT102	0	0	0	0	0	2118	3805	4898	5817	7049	8052
CT111	4073	3230	2994	4163	3079	0	0	0	0	0	
CT114	3477	4088	3894	3903	3757	4101	3912	3926	3867	3626	3912

FLYING HOURS	01	02	03	04	05	06	07	08	09	10	11
CT133	5122	1586	448	336	74	0	0	0	0	0	0
CT142	2259	2304	2328	2446	2660	2760	2483	2059	1931	1866	2139
CT145	3708	3951	4771	5079	3271	2141	3381	3087	3425	3411	3868
CT145A	0	0	0	0	0	0	0	0	763	1371	1315
CT146	0	0	0	0	38	93	67	980	2719	3847	4152
CT155	5128	7342	8383	8446	9137	8806	8714	6706	5836	7042	5462
CT156	13016	14474	15838	14942	13728	14722	16661	16554	14639	16049	17353
TRANSPORT	**29964**	**31708**	**26878**	**27007**	**27599**	**27740**	**26303**	**28190**	**28447**	**26714**	**28850**
CC115	2316	2120	2439	1839	2533	2065	1762	1703	1601	1751	1724
CC130	17902	19308	14945	15839	15442	16486	14870	14359	13963	10805	7900
CC130J	0	0	0	0	0	0	0	0	0	7580	4272
CC138	2455	1856	1923	1834	1962	1581	2166	2165	1830	1874	1420
CC144	2963	3157	2812	2979	2815	2706	2445	2712	3095	2815	2731
CC150	4328	5267	4760	4516	4847	4903	4483	4666	4402	4561	4959
CC177	0	0	0	0	0	0	577	2586	3555	4150	5844
UAV	**0**	**0**	**55**	**117**	**141**	**876**	**1031**	**1994**	**6193**	**6889**	**3493**
CU161	0	0	55	117	141	876	1031	1725	883	0	0
CU170	0	0	0	0	0	0	0	269	5310	6889	3493
CF TOTAL	**136329**	**142966**	**134612**	**130873**	**124743**	**122878**	**125395**	**126250**	**128898**	**133102**	**135664**
GLIDERS	**17634**	**16662**	**17068**	**16033**	**16149**	**15895**	**16050**	**15487**	**14628**	**16511**	**15823**
GRAND TOTAL	**153963**	**159627**	**151680**	**146906**	**140892**	**138773**	**141445**	**141738**	**143526**	**149613**	**151485**

Table 4 – Flying Hours by Aircraft Family and Type

3.2.2 Reporting of Occurrences

From Graph 2, a total of 3149 occurrences were reported; of these 56.27% were Air occurrences and the remaining 43.79% were Ground occurrences. This is almost identical to the reported occurrences compared to the previous year (3116) and remains above the 10-year mean value of 2968. The occurrence-reporting rate also decreased to 207.87 compared to 208.27 in 2010. The Damage/Injury –related occurrence rate has increased to 40.9 just slightly above the 10-year mean of 38.1. The No Damage/No injury rate has decreased to 166.9 but remains slightly above the 10 year mean of 164.1. When damage or injury occurs, the persons involved need to report the occurrence.



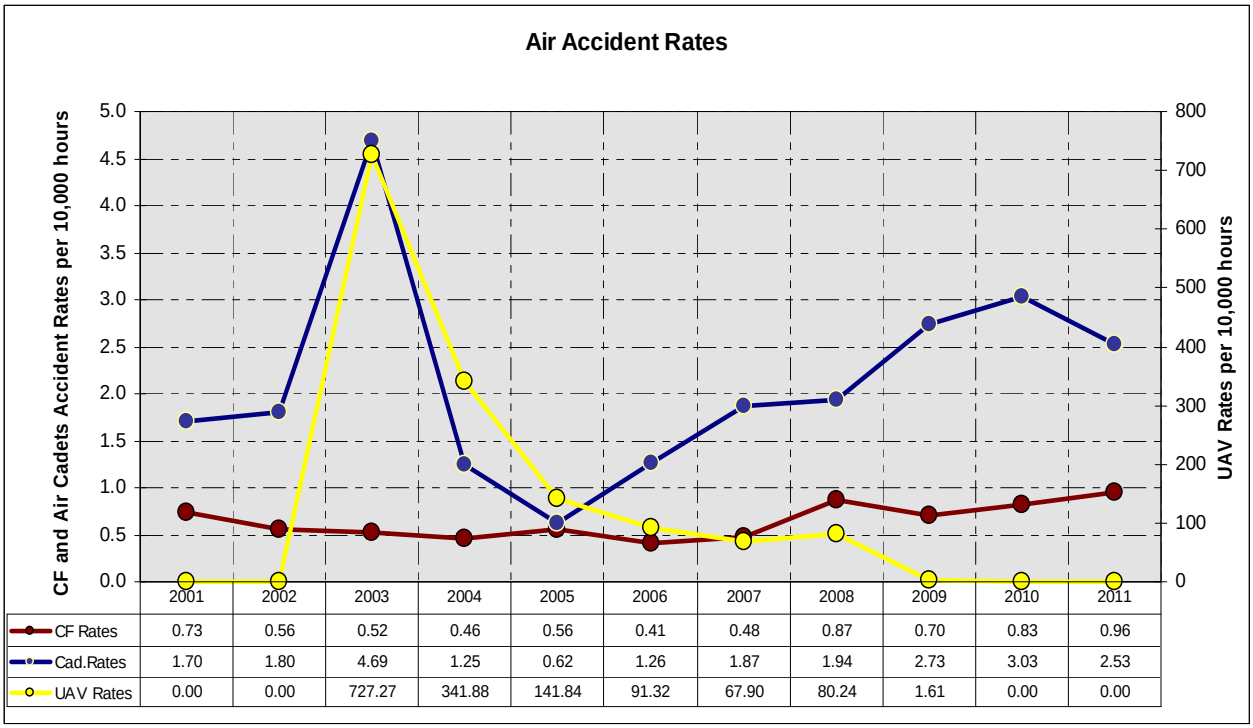
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Damage/Injuries Rates	29.6	25.6	23.6	36.7	45.1	44.2	42.0	48.7	49.5	39.0	40.9
No Damage/No Injuries Rates	170.2	158.7	162.8	159.9	168.9	148.4	151.2	161.5	190.1	169.3	166.9
Total Number of Occurrences	3077	2942	2827	2888	3016	2673	2733	2979	3438	3116	3149

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

From Graph 3, the overall CF Air Accident Rate, less Cadets and UAV accidents, has increased for the third year in a row compared to 2010 (0.96 vs. 0.83), and remains higher than the 10-year mean (0.66). The breakdown of air accidents was three category 'A' accidents (one CT155, one CH147 Chinook and one fatality) and 10 category 'C' accidents (two CH146, one CH139, one CC138 and six Pers injuries). The Air Cadets accident rate has decreased from last year's high (2.53 vs. 3.03). The 2011 accident rate is based on four accidents: two prop strikes, one hard landing and one nose over. Although statistical data for the Air Cadet program shows a decrease from last year's high (2.53 vs. 3.03) it remains above the previous 5-year mean (2.17) at Table 5. Although this series falls short of the statistical qualifier for a trend (six increases in a row), it does indicate a negative tendency that requires additional attention. In 2010, DFS recommended that D Cadets consider two 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. Results of D Cadets deliberations have yet to be received. The UAV accident rate was 0.0 (Graph 3) and reportable UAV operations have ceased.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CF Rates	0.73	0.56	0.52	0.46	0.56	0.41	0.48	0.87	0.70	0.83	0.96
Cad.Rates	1.70	1.80	4.69	1.25	0.62	1.26	1.87	1.94	2.73	3.03	2.53
UAV Rates	0.00	0.00	727.27	341.88	141.84	91.32	67.90	80.24	1.61	0.00	0.00

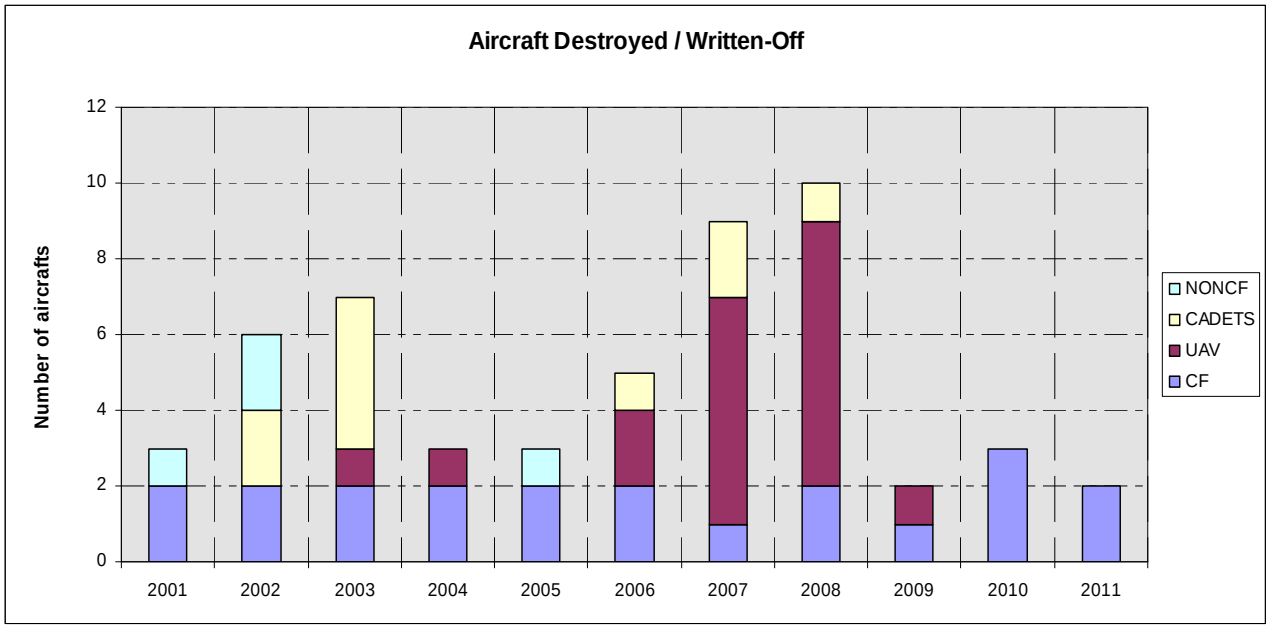
Graph 3 – Air Accident Rates
Note: 2003 Cadet outlier value discounted for the purposes of 10 year mean

Air Accident Rates	10	06-10 Mean	06-10 SD	11	D
CF Rates (Excluding Cadets and UAVs)	0.83	0.66	0.21	0.96	1.46
Cadets Rates	3.03	2.17	0.71	2.53	0.51
UAV Rates	0.00	48.21	44.07	0.00	-1.09

Table 5 - Air Accident Rates

3.2.3.2 Aircraft Destroyed/Written-Off

Two aircraft were destroyed, both in country and deployed to theatre of operations (one CT155 Hawk and one CH147 Chinook). 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. The CF rate is in line with the 10-year mean.



Graph 4 – Aircraft Destroyed / Written-Off
Note: 2010 Heron 255 UAV accident cooperation investigation not included to DFS statistical analysis.

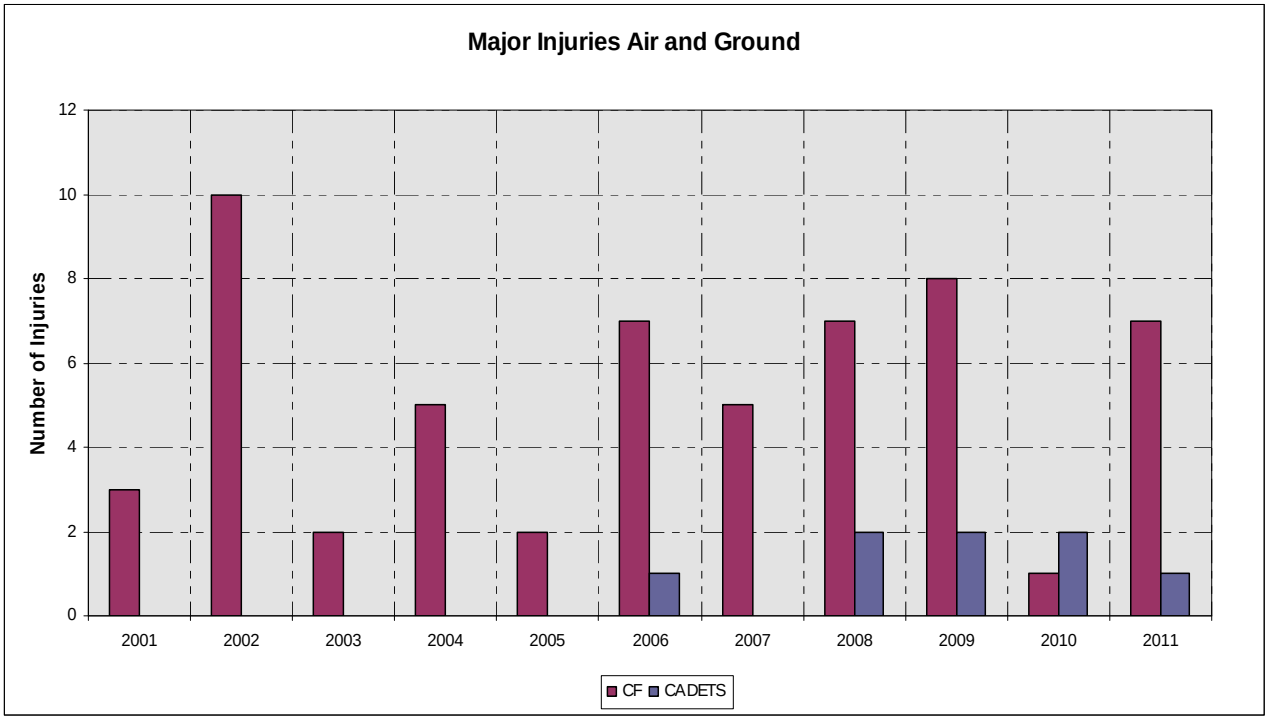
AIRCRAFT	01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
CF	2	2	2	2	2	2	1	2	1	3	1.9	0.6	2	0.2
UAV	0	0	1	1	0	2	6	7	1	0	1.8	2.6	0	-0.7
CADETS	0	2	4	0	0	1	2	1	0	0	1.0	1.3	0	-0.8
NONCF	1	2	0	0	1	0	0	0	0	0	0.4	0.7	0	-0.6
Total	**3**	**6**	**7**	**3**	**3**	**5**	**9**	**10**	**2**	**3**	**5.1**	**2.8**	2	**-1.1**

Table 6 – Aircraft Destroyed / Written-off
Note: 2010 Heron 255 UAV accident cooperation investigation not included to DFS statistical analysis.

3.2.4 Fatalities and Injuries

3.2.4.1 Major Injuries

There was one serious Cadet injury due to a hard landings and seven CF serious injuries (one SAR tech fatality, three SAR tech injured during a jump or landing, one rappeller rough landing and two additional injuries related to high G and hypoxia respectively). The major injuries are predominantly associated with SAR tech operations. The amount of serious injuries is almost double the 10-year mean and should be investigated further. The major injuries rate is greater than the 10-year average rate of 0.66, and marks the fourth consecutive year above the mean.



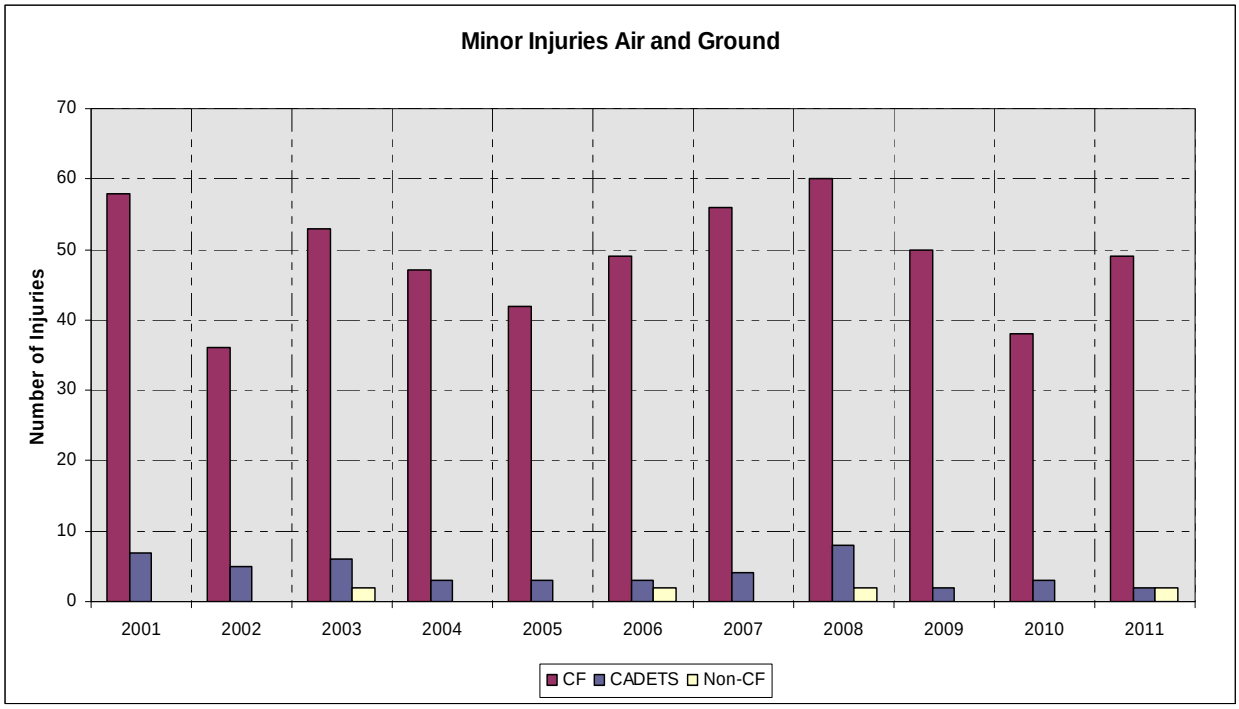
Graph 5 – Major Injuries Air and Ground

Year		01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
CF	Fatal	0	2	1	1	0	3	1	2	3	0	1.3	1.2	1	-0.3
	Very Serious	1	1	0	0	0	0	1	2	0	0	0.5	0.7	0	-0.7
	Serious	2	7	1	4	2	4	3	3	5	1	3.2	1.9	6	1.5
	Total	**3**	**10**	**2**	**5**	**2**	**7**	**5**	**7**	**8**	**1**	**5.0**	**3.07**	**7**	**0.7**
CADETS	Very Serious	0	0	0	0	0	0	0	1	0	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	0	1	0	1	2	2	0.6	0.8	1	0.5
	Total	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**2**	**2**	**0.7**	**0.9**	**1**	0.3

Table 7 – Major Injuries Air and Ground

3.2.4.2 Minor Injuries

Graph 6 shows a total of 49 minor injuries occurred in 2011, an increase from 38 in 2010. Although this is a 29% increase, the rate remains within one standard deviation. Table 8 shows a potential area of concern for Non-CF minor injuries. A review of the subject occurrences showed they were from different units and could represent a statistical anomaly due to the limited sample size (two).



Graph 6 - Minor Injuries Air and Ground

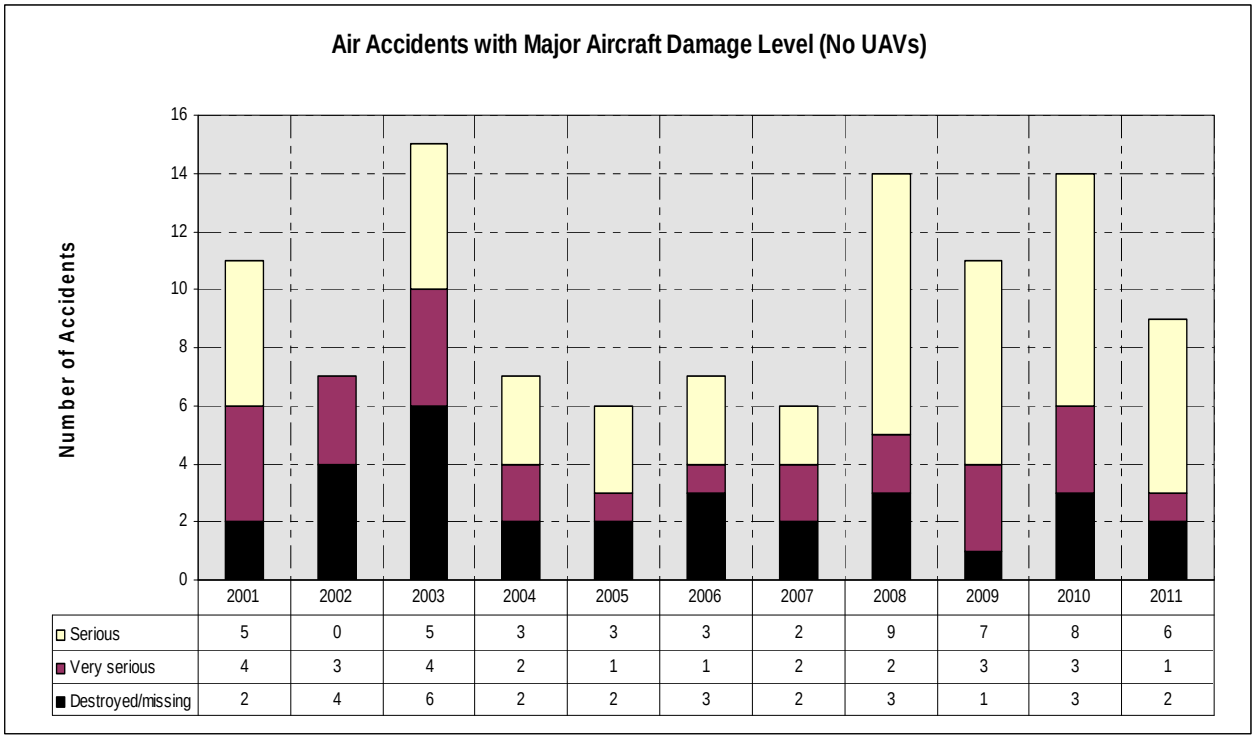
Year	01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
Cadets	7	5	6	3	3	3	4	8	2	3	4.4	2.0	2	-1.2
CF	58	36	53	47	42	49	56	60	50	38	48.9	8.2	49	0.0
Non-CF	0	0	2	0	0	2	0	2	0	0	0.6	1.0	2	1.4
Total	**65**	**41**	**61**	**50**	**45**	**54**	**60**	**70**	**53**	**41**	**53.9**	**10.4**	**53**	**-0.1**

Table 8 - Minor Injuries Air and Ground

3.2.5 Aircraft Damage Level (ADL)

3.2.5.1 Air Accidents with Major ADL

The number of occurrences with major ADL (excluding UAVs) was nine with two CF aircraft destroyed. Although above the mean, this is seen as a positive change considering the previous three years. (Graph 7).



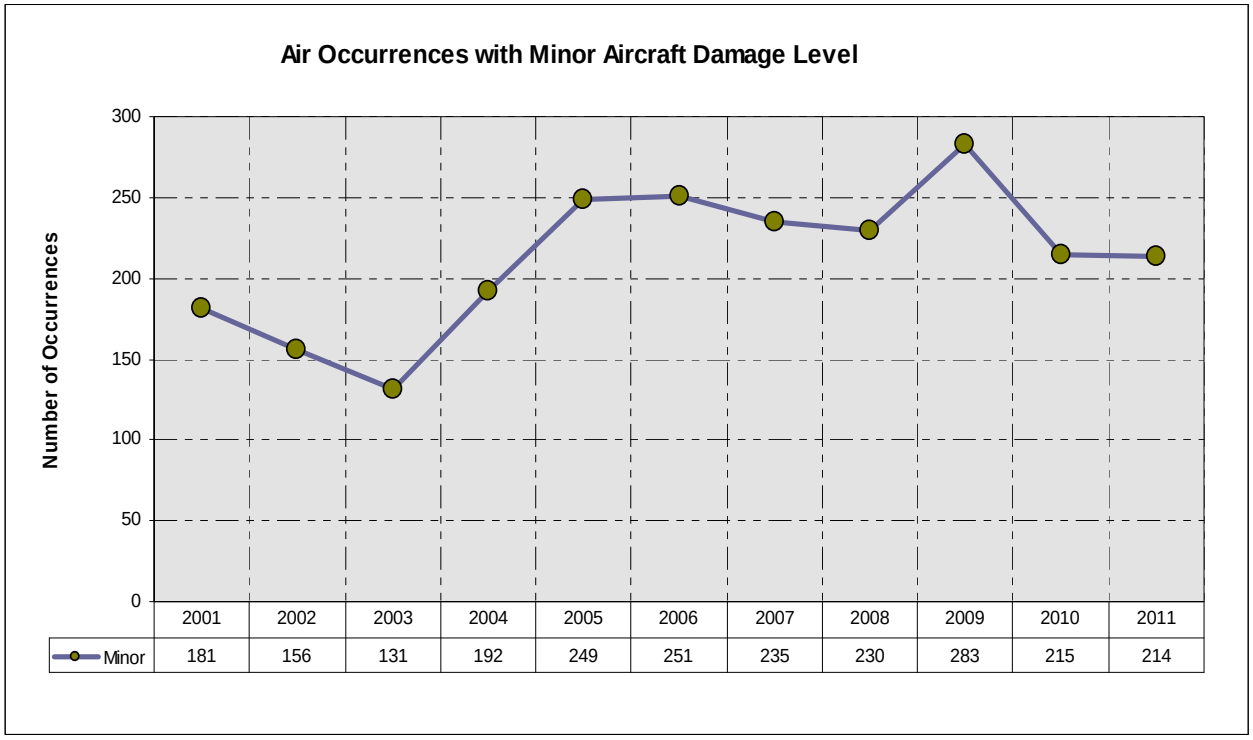
Graph 7 – Air Accidents by Major Aircraft Damage Level (No UAVs)

MAJOR ADL BY A/C TYPE		01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
CADETS	Destroyed	0	2	4	0	0	1	1	1	0	0	0.9	1.3	0	-0.7
	Very Serious	3	1	1	1	1	1	1	2	2	3	1.6	0.8	1	-0.7
	Serious	0	0	3	1	0	0	1	0	2	1	0.8	1.0	2	1.2
	Total	**3**	**3**	**8**	**2**	**1**	**2**	**3**	**3**	**4**	**4**	**3.3**	**1.9**	**3**	**-0.2**
CF	Destroyed	2	2	2	2	2	2	1	2	1	3	1.9	0.6	2	0.2
	Very Serious	1	2	3	1	0	0	1	0	1	0	0.9	1.0	0	-0.9
	Serious	5	0	2	2	3	3	1	9	5	7	3.7	2.8	4	0.1
	Total	**8**	**4**	**7**	**5**	**5**	**5**	**3**	**11**	**7**	**10**	**6.5**	**2.6**	**6**	**-0.2**
UAV	Destroyed	0	0	1	1	0	2	6	7	1	0	1.8	2.6	0	-0.7
	Very Serious	0	0	1	2	0	5	0	9	0	0	1.7	3.0	0	-0.6
	Serious	0	0	2	1	2	1	1	0	0	0	0.7	0.8	0	-0.9
	Total	**0**	**0**	**4**	**4**	**2**	**8**	**7**	**16**	**1**	**0**	**4.2**	**5.1**	**0**	**-0.8**
Total		**11**	**7**	**19**	**11**	**8**	**15**	**13**	**30**	**12**	**14**	**14.0**	**6.6**	**9**	**-0.8**

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

3.2.5.2 Air Occurrences with Minor ADL

In 2011, the number of occurrences with minor ADL was almost identical to 2010 (214 vs 215) (Graph 8).



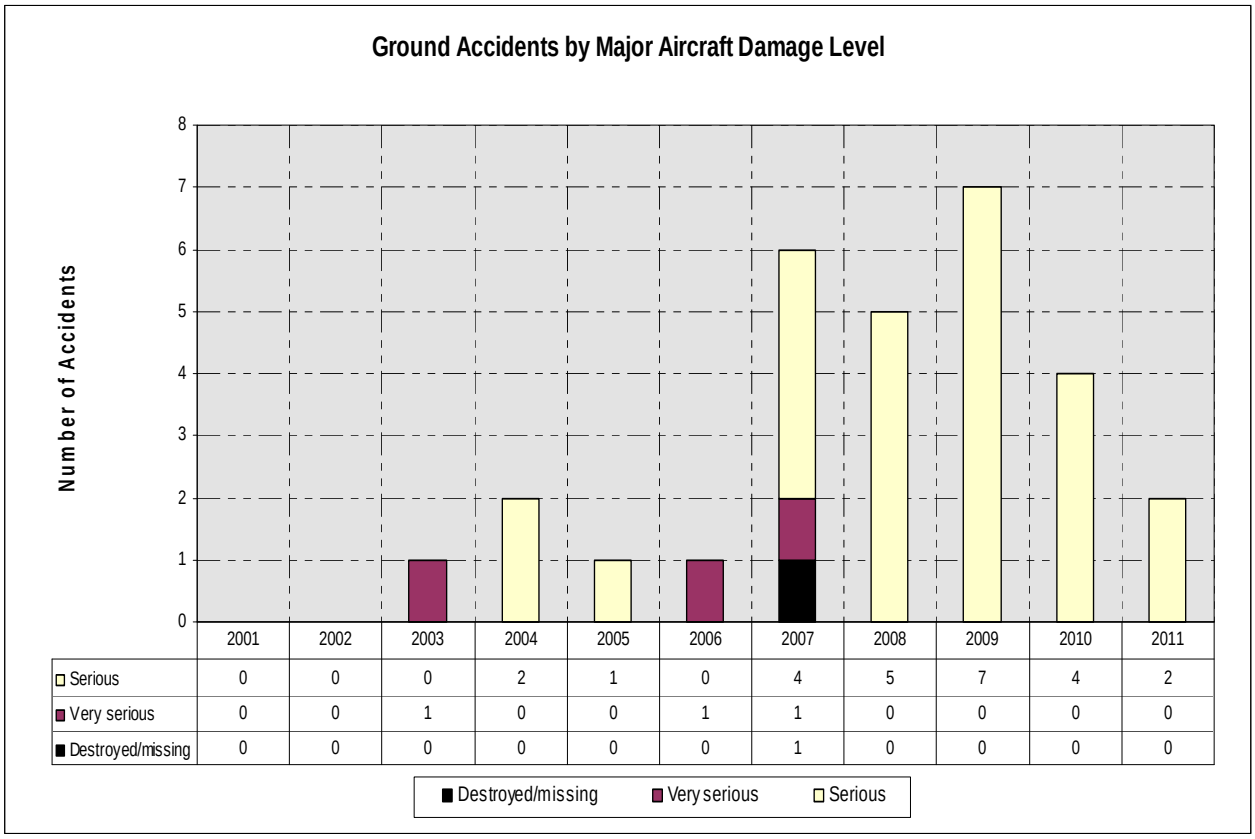
Graph 8 – Air Occurrences with Minor Aircraft Damage Level

AIR OCCURRENCES WITH MINOR ADL	01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
CADETS	10	20	11	8	10	19	11	19	17	9	13.4	4.7	11	-0.5
CF	171	136	118	181	236	209	216	203	258	204	193.2	42.9	204	0.3
UAV	0	0	2	3	3	23	8	8	9	2	5.8	6.9	0	-0.8
Total	**181**	**156**	**131**	**192**	**249**	**251**	**235**	**230**	**283**	**215**	**212.4**	**47.1**	**214**	**0.1**

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 continued to decrease in 2011 from the last four year peek (Graph 9 and Table 11). The two serious ground accidents involved CH146, both of which were preventable.



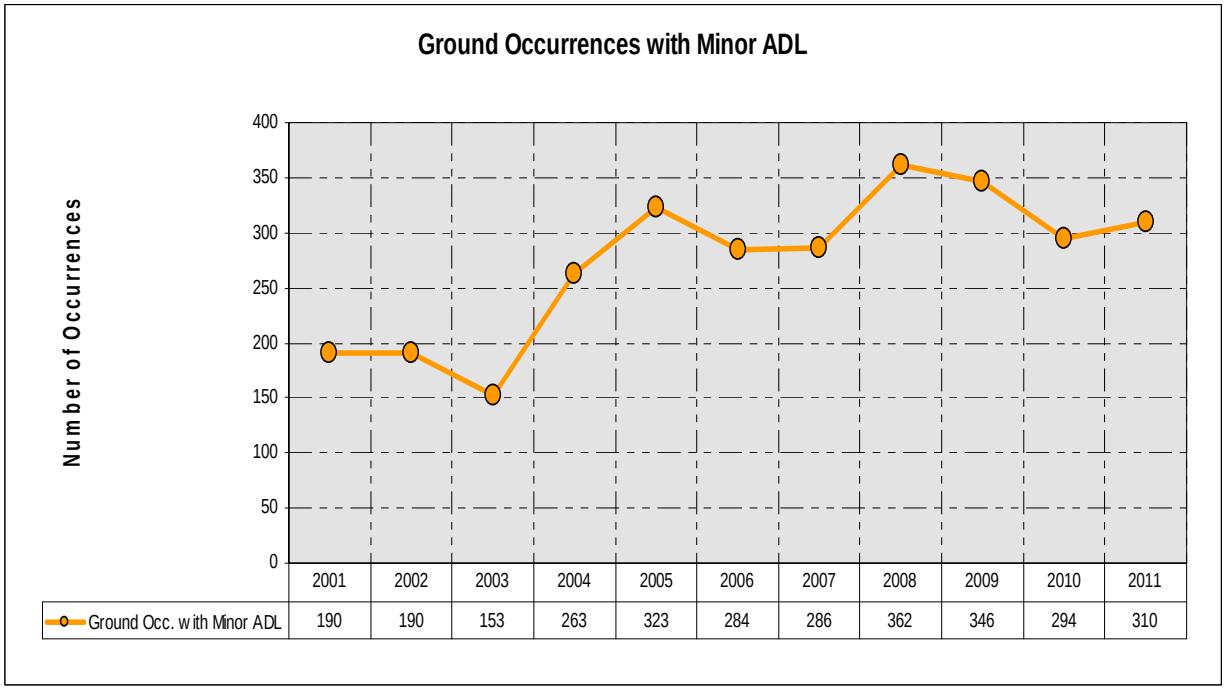
Graph 9 – Ground Accidents by Aircraft Damage Level

GROUND ACCIDENTS WITH MAJOR ADL BY A/C TYPE		01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
CADETS	Destroyed	0	0	0	0	0	0	01	0	0	0	0.1	0.3	0	-0.3
	Very Serious	0	0	0	0	0	1	0	0	0	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	0	0	0	0	0	2	0.2	0.6	0	n/a
	Total	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**2**	**0.4**	**0.7**	**0**	**-0.6**
CF	Very Serious	0	0	1	0	0	0	0	0	0	0	0.1	0.3	0	-0.3
	Serious	0	0	0	2	1	0	4	5	6	2	2.1	2.3	2	0.0
	Total	**0**	**0**	**1**	**2**	**1**	**0**	**4**	**5**	**6**	**2**	**2.1**	**2.2**	**2**	**0.0**
UAV	Very Serious	0	0	0	0	0	0	1	0	0	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	0	0	0	0	1	0	0.1	0.3	0	-0.3
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0.2**	**0.4**	**0**	**-0.5**
Total		**0**	**0**	**1**	**2**	**1**	**1**	**6**	**5**	**7**	**4**	**2.7**	**2.6**	**2**	**-0.3**

Table 11 – Ground Accidents Sorted by type and Major ADL

3.2.5.4 Ground Occurrences with Minor ADL

The number of ground occurrences with minor ADL has increased slightly from the previous year (Graph 10 and Table 12). Although the number is above the 10-year mean, it is within one standard deviation and as such is expected. The threshold shift since 2003 merits closer analysis in order to identify the main contributing factors.



Graph 10 – Ground Occurrences with Minor Aircraft Damage Level

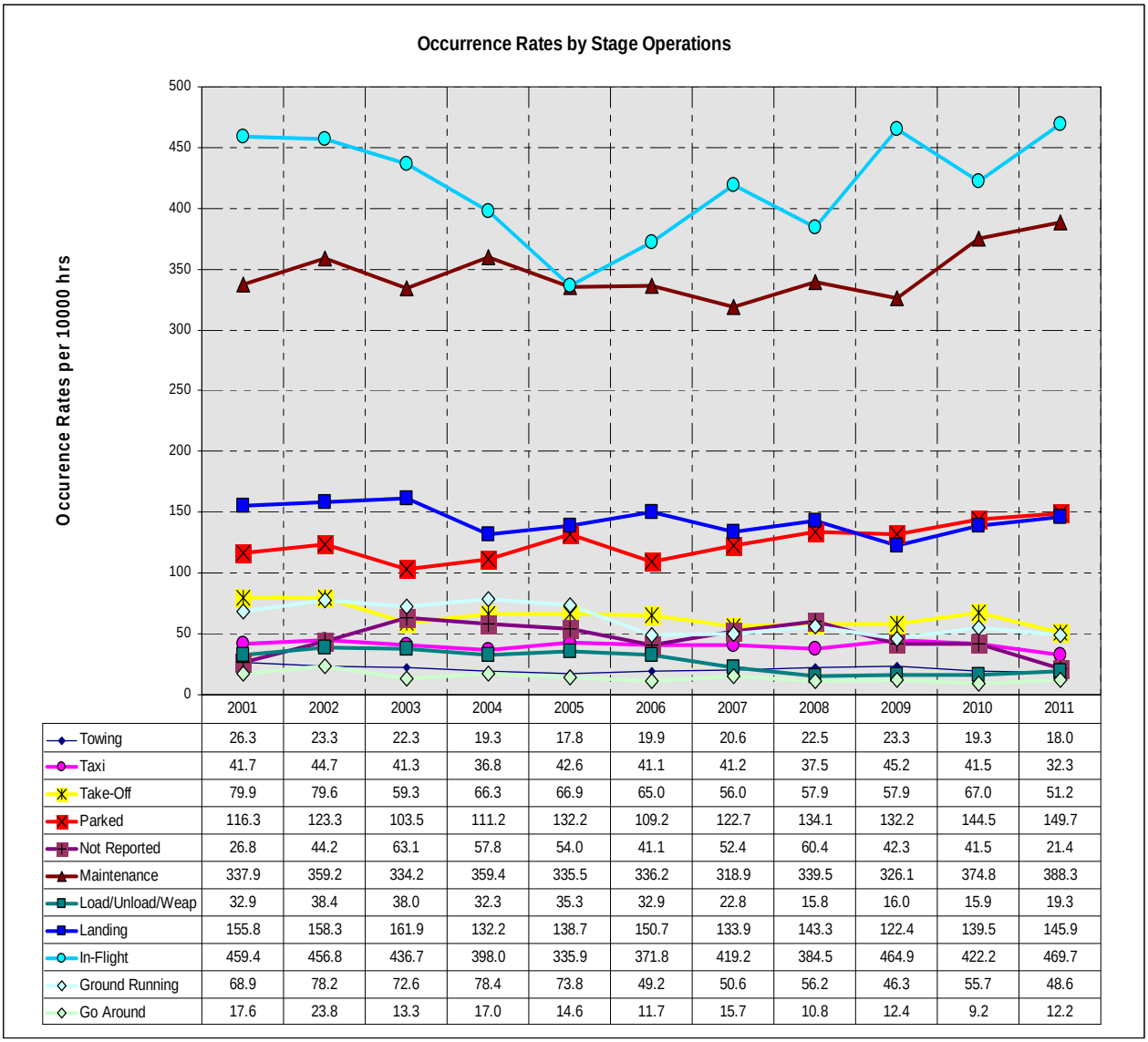
GROUND OCCURRENCE WITH MINOR ADL BY ORGANISATION	01	02	03	04	05	06	07	08	09	10	01-10 Mean	01-10 SD	11	D
CADETS	6	14	10	5	13	8	15	22	14	9	11.6	5.1	14	0.5
CF	184	176	141	257	309	276	269	340	331	285	256.8	68.1	296	0.6
UAV	0	0	2	1	1	0	2	0	1	0	0.7	0.8	0	-0.9
Total	**190**	**190**	**153**	**263**	**323**	**284**	**286**	**362**	**346**	**294**	**269.1**	**70.4**	**310**	**0.6**

Table 12 – Ground Occurrences with Minor ADL by organisation

3.2.5.5 Occurrences by Stage of Operations

There are three stages of operations that have shown an increase with D values above the normal variation (Parked, Maintenance and In-flight). The Maintenance stage (D=2.7) remains elevated from the previous year and requires additional examination by maintenance staff. The Parked

and In-flight stages will require close monitoring.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Towing	26.3	23.3	22.3	19.3	17.8	19.9	20.6	22.5	23.3	19.3	18.0
Taxi	41.7	44.7	41.3	36.8	42.6	41.1	41.2	37.5	45.2	41.5	32.3
Take-Off	79.9	79.6	59.3	66.3	66.9	65.0	56.0	57.9	57.9	67.0	51.2
Parked	116.3	123.3	103.5	111.2	132.2	109.2	122.7	134.1	132.2	144.5	149.7
Not Reported	26.8	44.2	63.1	57.8	54.0	41.1	52.4	60.4	42.3	41.5	21.4
Maintenance	337.9	359.2	334.2	359.4	335.5	336.2	318.9	339.5	326.1	374.8	388.3
Load/Unload/Weap	32.9	38.4	38.0	32.3	35.3	32.9	22.8	15.8	16.0	15.9	19.3
Landing	155.8	158.3	161.9	132.2	138.7	150.7	133.9	143.3	122.4	139.5	145.9
In-Flight	459.4	456.8	436.7	398.0	335.9	371.8	419.2	384.5	464.9	422.2	469.7
Ground Running	68.9	78.2	72.6	78.4	73.8	49.2	50.6	56.2	46.3	55.7	48.6
Go Around	17.6	23.8	13.3	17.0	14.6	11.7	15.7	10.8	12.4	9.2	12.2

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

OCCURRENCE RATES BY STAGE OF OPERATION	10	01-10 Mean	01-10 SD	11	D
Towing	19.3	21.5	2.5	18.0	-1.3
Taxi	41.5	41.3	2.7	31.9	-3.6
Take-Off	67.0	65.6	13.0	50.8	-1.7
Parked	144.5	122.9	13.0	149.3	2.0
Not Reported	41.5	48.3	11.2	23.9	-2.2
Maintenance	374.8	342.2	17.1	388.9	2.7
Load/Unload/W. Handling	15.9	28.0	9.4	18.9	-1.0
Landing	139.5	143.7	12.7	145.6	0.1
In-Flight	422.2	414.9	42.3	469.0	1.3
Ground Running	55.7	63.0	12.6	48.7	-1.1
Go Around	9.2	14.6	4.2	12.2	-0.6

Table 13 - Occurrence Rates by Stage of Operation

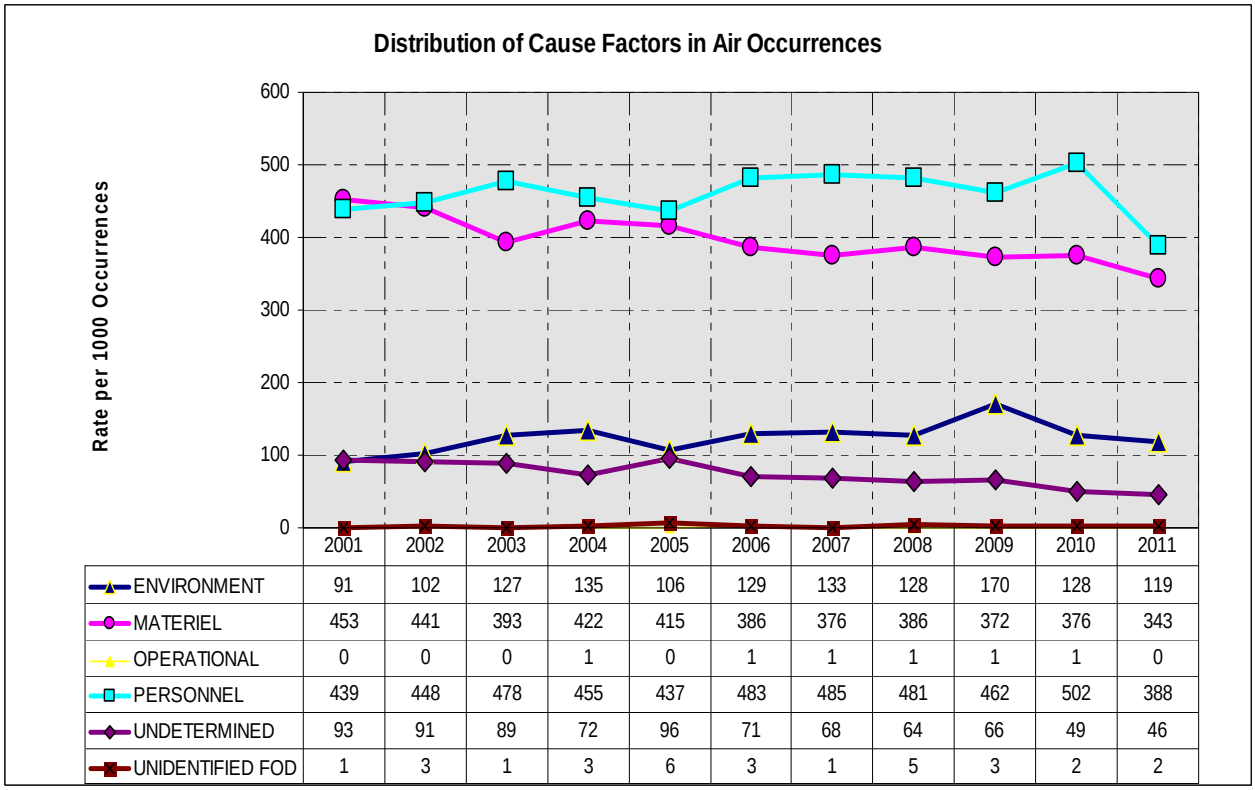
3.3 CAUSE FACTORS

3.3.1 Cause Factor Breakdown Analysis

To achieve consistency for section 3.3.1, only data from reports with the following status codes were used: supplemental sent, combined sent, amended supplemental sent, and amended combined sent. Data for all other draft reports was omitted because they are incomplete. This year is particularly critical due to the amount of occurrences entered in FSOMS that were overdue (509 of the 3149) at the time of the report (247 Air and 262 Ground). This introduces a level of uncertainty of 13.9% for air and 19% for ground occurrences towards the analysis of cause factors and any comparison to previous years. DFS continues to track monthly for overdue reports to validate distribution hypothesis. This should initially resolve the analysis of cause factors and provide some solution towards resilience.

3.3.1.1 Air Occurrences

Graph 12 and Table 14 provide a breakdown of the attribution of air occurrence cause factors for 2011. Although the data indicates a distinct decrease in the personnel and materiel cause factors, analysis of the distribution is incomplete as a result of 247 overdue occurrence reports.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ENVIRONMENT	91	102	127	135	106	129	133	128	170	128	119
MATERIEL	453	441	393	422	415	386	376	386	372	376	343
OPERATIONAL	0	0	0	1	0	1	1	1	1	1	0
PERSONNEL	439	448	478	455	437	483	485	481	462	502	388
UNDETERMINED	93	91	89	72	96	71	68	64	66	49	46
UNIDENTIFIED FOD	1	3	1	3	6	3	1	5	3	2	2

Graph 12 - Distribution of Cause Factors in Air Occurrences

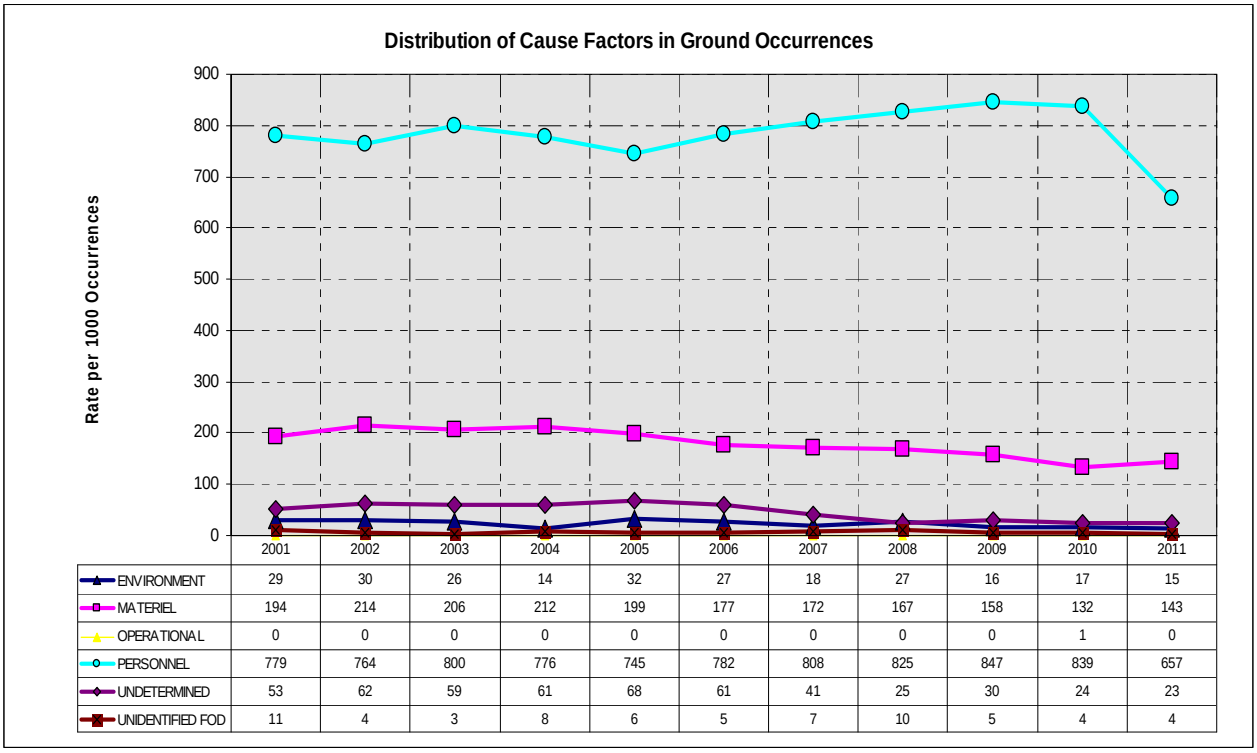
Note: The Nil (FTPO) factor is not considered in graph 12.

Air Cause Factors Rates by Type	2010	01-10 Mean	01-10 SD	2011	D
Environment	128	125.0	21.8	119	-0.3
Materiel	376	401.9	28.9	343	-2.0
Operational	1	0.5	0.5	0	-1.0
Personnel	502	467.0	21.9	388	-3.6
Undetermined	49	76.0	15.3	46	-1.9
Unidentified FOD	2	2.7	1.7	2	-0.6

Table 14 - Air Cause Factors Rates by Type

3.3.1.2 Ground Occurrences

Graph 13 and Table 15 provide a breakdown of the attribution of ground occurrence cause factors for 2011. Although the data indicates a distinct decrease in the personnel and a slight increase in the materiel cause factors, analysis of the distribution is incomplete as a result of the 262 overdue occurrence reports.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
ENVIRONMENT	29	30	26	14	32	27	18	27	16	17	15
MATERIEL	194	214	206	212	199	177	172	167	158	132	143
OPERATIONAL	0	0	0	0	0	0	0	0	0	1	0
PERSONNEL	779	764	800	776	745	782	808	825	847	839	657
UNDETERMINED	53	62	59	61	68	61	41	25	30	24	23
UNIDENTIFIED FOD	11	4	3	8	6	5	7	10	5	4	4

Graph 13 - Distribution of Cause Factors in Ground Occurrences

Note: The Nil (FTPO) factor is not considered in graph 13.

Ground Cause Factors Rates by Type	2010	01-10 Mean	01-10 SD	2011	D
Environment	17	23.6	6.8	15	-1.3
Materiel	132	183	26.5	143	-1.5
Operational	1	0.1	0.2	0	-0.3
Personnel	839	796.2	33.3	657	-4.2
Undetermined	24	48.3	16.9	23	-1.5
Unidentified FOD	4	6.5	2.7	4	-1.1

Table 15 - Ground Cause Factors Rates by Type

3.3.1.3 Comparison of Cause Factors Rates for Air and Ground Occurrences

At the time of the report, both Table 14 and Table 15 indicated a marked decrease in the personnel cause factors for air and ground occurrences. These data points are currently considered as outliers due to the excessive D value. DFS will continue to track the data until the majority of the occurrence reports are completed. Comparative analysis will then be updated.

3.3.2 HFACS Data

3.3.2.1 Analysis

HFACS analysis methodology provides an opportunity to identify the level of randomness in the data. A low level of randomness will normally imply the systemic presence of the cause factor in the occurrences. One reason for these patterns could be the increasing/decreasing trends of monthly occurrences. Another reason could be the change of reporting methodology. The DFS Human factors specialist reviewed the Human factors Analysis and Classification System (HFACS) for assigning human errors in the Flight Safety Occurrence Management System. The resulting observations and recommendations were briefed to DFS. Nevertheless Perception errors (Air/Ground), Physical environment (Air) and Organisational climate (Air) have been identified as areas of concern that require additional analysis.

CAUSE FACTORS		TYPE	CAUSE FACTORS vs. REPORTS FILED			
			Mean 04-10	2010	2011	RL 04-11
ACTIVE FAILURES						
ERRORS	**Decision Error**	**Air**	137.2	163.7	146.0	Medium
		Ground	194.2	219.1	203.6	Medium
	Perception Error	**Air**	45.4	75.4	76.7	Very Low
		Ground	48.5	104.0	96.0	Very Low
	Skilled Based Error	**Air**	346.9	349.8	290.3	Very Low
		Ground	507.6	571.4	521.5	Medium
DEVIATIONS	**Routine Deviation**	**Air**	6.3	6.2	2.3	High
		Ground	19.9	21.7	16.7	Medium
	Exceptional Deviation	**Air**	16.9	7.9	9.0	High
		Ground	60.8	34.4	26.2	Very Low
LATENT CONDITIONS						
CONDITIONS OF PERSONNEL	**Mental State**	**Air**	271.0	306.0	279.6	Very-Low
		Ground	408.7	497.4	469.8	Very Low
	Physical / Mental Capabilities	**Air**	47.5	56.2	36.1	Very Low
		Ground	60.7	63.6	49.5	Medium
	Physiological States	**Air**	4.6	3.4	4.5	Very Low
		Ground	3.4	0.0	0.0	Low
WORKING CONDITIONS	**Technological Environment**	**Air**	20.6	24.2	26.5	Medium

CAUSE FACTORS		TYPE	CAUSE FACTORS vs. REPORTS FILED			
			Mean 04-10	2010	2011	RL 04-11
		Ground	35.4	35.9	24.0	Low
	Physical Environment	Air	30.5	36.6	44.0	Very Low
		Ground	49.7	69.6	52.4	Very Low
PRACTICES OF PERSONNEL	Resource Management	Air	68.6	99.0	62.6	Very Low
		Ground	92.2	119.7	93.8	Medium
	Personal Readiness	Air	1.5	1.1	0.6	n/a
		Ground	1.5	2.2	1.5	n/a
SUPERVISION	Planned Activities	Air	14.3	18.0	11.8	High
		Ground	36.0	32.9	29.8	Very Low
	Problem Correction	Air	8.3	7.9	5.1	Low
		Ground	23.7	18.0	21.8	High
	Supervisory Deviation	Air	1.9	2.2	3.4	n/a
		Ground	9.9	9.0	8.7	Medium
	Level of Supervision	Air	50.9	62.4	41.1	Low
		Ground	144.5	163.8	161.5	High
ORG INFLUENCES	Organizational Climate	Air	9.8	12.4	16.3	Medium
		Ground	26.3	36.6	29.1	Very Low
	Organizational Process	Air	23.9	18.0	16.9	High
		Ground	62.7	53.1	48.0	High
	Resource Management	Air	12.5	10.1	9.0	High
		Ground	35.2	39.6	32.0	Very Low

Table 16 - Air & Ground Occurrences - HFACS Cause Factor Percentage Breakdown
Note: The table is (#Occurrences per Factor/ #Reports Filed (air or ground)) * 1000

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 17). These rates were also analyzed 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 01-10	10	11	RL 01-11
ALL A/C	**N/A**	**169.9**	**154.4**	**153.5**	**Medium**
CC115 Buffalo	**Overall**	**311.2**	**279.8**	**306.1**	**Very low**
	Weapons systems	52.7	40.0	56.2	Very low
	Flight Instruments	10.7	28.6	43.7	n/a
	Undercarriage (landing gear)	29.9	28.6	37.5	Low
CC130 Hercules	**Overall**	**242.4**	**278.6**	**284.9**	**Very Low**
	Weapons Systems	20.0	47.2	69.9	Very low
	Propeller/Engine Controls /Instruments	21.6	33.3	39.6	Low
	Propeller	17.8	25.9	22.4	Low
CC138 Twin Otter	**Overall**	**86.2**	**136.6**	**129.0**	**Medium**
	Fuselage/Wings/Empennage	7.1	16.4	39.3	Medium
	Electrical Systems	10.0	0.0	16.8	Medium
	Survival & Safety Equipment	4.3	16.4	11.2	High
CC144 Challenger	**Overall**	**27.1**	**25.8**	**32.0**	**Very Low**
	Controls (Other)	1.4	6.5	10.7	n/a
	Hydraulics	1.0	3.2	3.6	n/a
	Elevators and Stabilator	1.1	0.0	3.6	n/a
CC150 Polaris (Airbus 310)	**Overall**	**40.2**	**30.0**	**30.3**	**Very Low**
	Fuel Systems	2.7	4.6	11.7	High
	Electrical Systems	0.5	2.3	4.7	n/a
	Flaps	1.8	2.3	2.3	n/a
CC177 Globemaster III	**Overall**	**144.2**	**64.7**	**44.7**	**n/a**
	Jet / Turbo Basic Engine	7.6	5.6	7.9	n/a
	Furnishings And Loose Equipment	12.5	2.8	7.9	n/a
	Lubrication Systems	13.4	5.6	5.3	n/a
CF188 Hornet	**Overall**	**353.6**	**301.6**	**327.5**	**Medium**
	Weapons Systems	64.6	65.4	78.1	High
	Survival & Safety Equipment	30.7	44.9	46.3	High
	Undercarriage (Landing Gear)	44.9	37.0	38.7	High
CH124 Sea King	**Overall**	**182.5**	**131.3**	**156.3**	**Low**
	Other	10.4	6.4	17.1	Medium
	Survival & Safety Equipment	11.2	6.4	15.8	Medium
	Panels / Doors / Transparent Areas	9.9	10.3	13.1	Medium

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 01-10	10	11	RL 01-11
CH139 Jet Ranger Bell 206B	**Overall**	**46.2**	**198.7**	**76.3**	**Low**
	Helo Main Rotor Head / Rotor Drive Train	5.4	37.6	27.3	n/a
	Helicopter Flight Controls	11.4	59.1	16.4	n/a
	Jet / Turbo Basic Engine	3.2	21.5	16.4	n/a
CH146 Griffon	**Overall**	**136.4**	**125.7**	**169.3**	**High**
	Helicopter Flight Controls	22.4	22.0	27.8	Medium
	Helo Main Rotor Head / Rotor Drive Train	11.2	17.3	21.6	Low
	Gearboxes / Accessories / Drives	6.5	8.9	12.5	High
CH149 Cormorant	**Overall**	**525.7**	**215.4**	**295.5**	**Medium**
	Furnishings and Loose Equipment	95.0	51.3	86.2	Medium
	Helicopter Flight Controls	80.8	24.6	36.9	Low
	Panels / Doors / Transparent Areas	40.9	20.5	32.0	Medium
CP140 Aurora	**Overall**	**229.5**	**281.7**	**200.4**	**High**
	Weapon Systems	17.8	28.2	25.5	High
	Electrical Systems	25.4	31.9	18.2	Medium
	Fuselage / Wings / Empennage	13.8	13.1	16.4	Medium
CT102 Astra	**Overall**	**92.4**	**103.1**	**48.2**	**Medium**
	Undercarriage (Landing Gear)	16.8	12.0	11.3	High
	Fuselage / Wings / Empennage	14.0	15.5	4.3	High
	Electrical Systems	6.8	3.4	4.3	n/a
CT114 Tutor	**Overall**	**137.9**	**186.2**	**162.8**	**Medium**
	Undercarriage (Landing Gear)	18.7	31.0	30.4	Medium
	Survival & Safety Equipment	16.7	38.8	24.8	High
	Fuselage / Wings / Empennage	21.4	12.9	22.1	Very low
CT142 Dash-8	**Overall**	**47.3**	**48.4**	**67.7**	**Very Low**
	Undercarriage (Landing Gear)	6.1	9.2	9.3	n/a
	Fuselage / Wings / Empennage	3.9	6.9	7.0	n/a
	Panels / Doors / Transparent Areas	4.6	0.0	7.0	n/a
CT145 King Air	**Overall**	**38.4**	**40.9**	**52.8**	**High**
	Fuselage / Wings / Empennage	2.7	2.9	14.7	n/a
	Undercarriage (Landing Gear)	9.7	20.4	8.8	High
	Flaps	4.9	2.9	8.8	n/a
CT155	**Overall**	**322.0**	**131.9**	**102.2**	**Low**
	Undercarriage (Landing Gear)	66.4	32.6	17.0	Very Low

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 01-10	10	11	RL 01-11
Hawk	Flaps	14.6	10.3	17.0	High
	Fuselage / Wings / Empennage	45.7	20.6	15.6	High
CT156 Harvard II	**Overall**	**190.4**	**64.2**	**54.8**	**Very Low**
	Undercarriage (Landing Gear)	62.4	21.9	16.8	Medium
	Survival & Safety Equipment	24.2	8.9	10.0	High
	Flaps	13.4	5.5	6.9	High

Table 17 - System Descriptor rates by Fleet
Note: The colour code is based on the D value. CC130J and CT146 fleets were excluded due to limited data.

3.3.3.1 Fleet Concerns

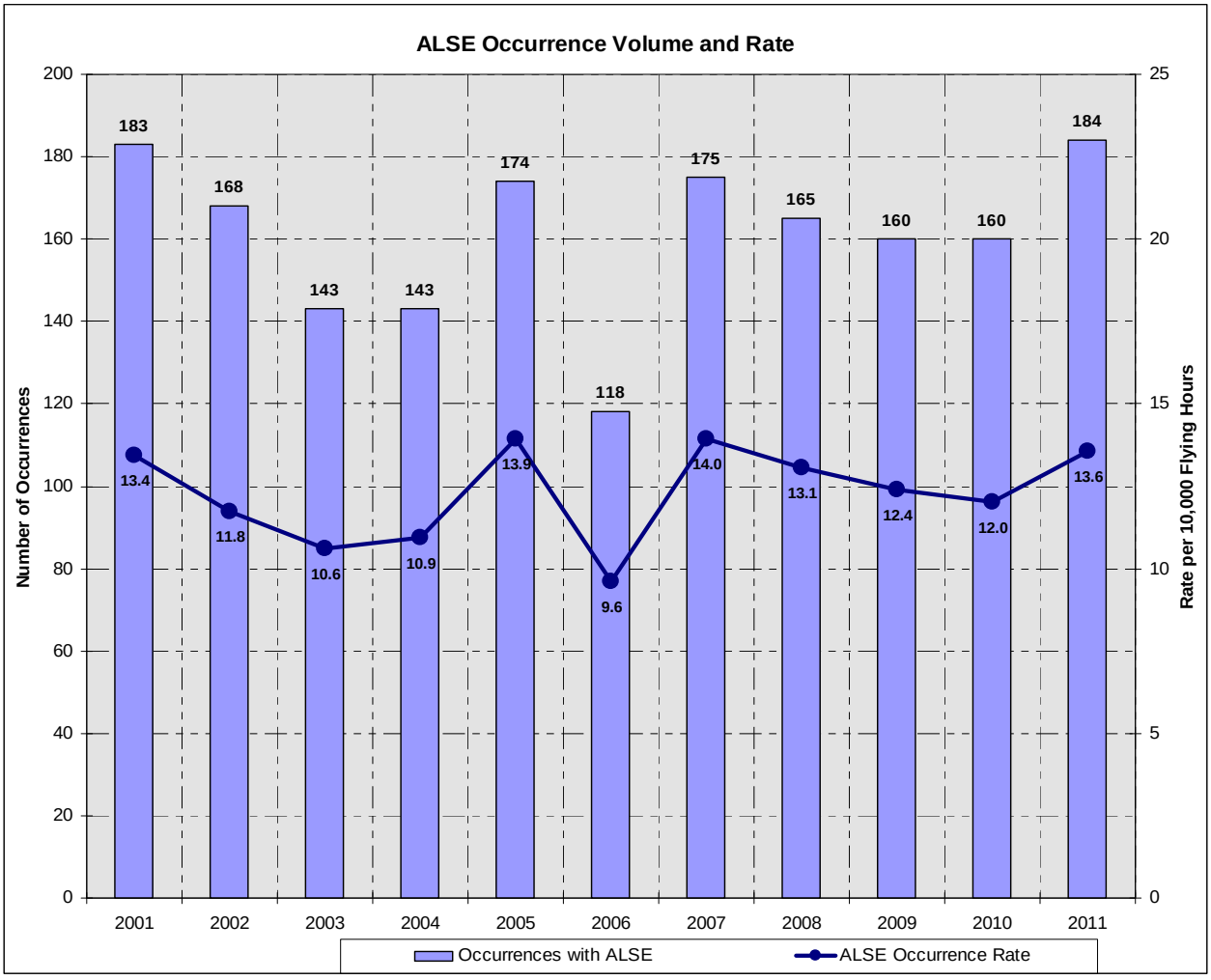
- CC115. There are no FS concerns at this time.
- CC130. There are with 54 open/active RARMs, 35 resulting from the hypoxia. Propeller Low Oil Light indications will continue to be a concern with the legacy CC130 fleet until a proper redesign of the system can be implemented. The weapons systems concerns issues with smoke and flare malfunctions.
- CC138. There were 14 occurrence reports categorized as documentation related (14 of 38). The occurrences concerning Fuselage/Wings/Empennage were reviewed and found to be of no concern.
- CC144. Although there are no FS concerns at this time, the lack of reported ground occurrences during the two previous years is highly unusual when compared to other CF fleets.
- CC150. There are no FS concerns at this time.
- CC177. There are no FS concerns at this time. Trending information is limited due to the short time in service and the number of open occurrence reports for 2011 (22 of 56).
- CF188. There are no FS concerns at this time.
- CH124. There are no FS concerns at this time.
- CH139. There are no FS concerns at this time.
- CH146. There were 37 occurrences involving Helo Main Rotor Head /Rotor Drive Train System. These were quite random and unrelated. This factor isn't considered indicative of a trend.
- CH149. The are currently 46 open preventive measure from FS investigations. Significant FS occurrences and trends included communication system issues, cabin or cockpit fumes, hoist issues (21 of 160 occurrences). QETE continues to research hoist issues, main gear box and tail rotor half hub cracking and Limit Cycle Oscillations.
- CP140. There were no trends of note, however, there continues to be a number of FS occurrences due to known but unresolved issues. There were five cases of Smoke/Fumes

in the aircraft, five cases of inadvertent activation of the Emergency Audio Panel (EAP) (up from two in the previous reporting period) and seven cases of P-Static induced loss of communications. A hazard report has also been initiated and a LOW risk RARM and Working Group are in place. The EAP issue has also been RARM'd (LOW risk) and a technical fix is expected by Dec 12.

- CT102. Although there are no FS concerns at this time, this fleet experiences a rather low number of ground occurrences.
- CT114. There are no FS concerns at this time. Trending information is limited due to the number of overdue occurrence reports for 2011.
- CT142. Although there are no FS concerns at this time, Defence Resource Information Management System (DRIMS) was identified as a documentation issue in six of 42 occurrences for 2011.
- CT145. Although there are no FS concerns at this time, a unit level accepted PM is pursuing the possibility of removing the order restricting aircraft from starting or taxiing next to an aircraft being refuelled.
- CT155. There are five FS concerns; Low Pressure Turbine blade root cracking, parachute excessive descent rate, SCH triangular void, LP/SV bladder puncture susceptibility following ejection and Pilot neck strain. The first four were addressed by RARM. There were four near mid-air occurrences during the reporting period.
- CT156. There has been a significant number of near mid-air collision (12) over the reporting period. Although the Technical Airworthiness Manual RARM process identified the risk level as high, 15 Wing Moose Jaw had produced a RORM indicating the near mid-air collision (NMAC) risk level was medium. This has done little to prevent the increase in NMACs over the last reporting period.
- CH147. There are no FS concerns at this time and this CH147D fleet has ceased operation. Remaining concerns have been passed on to the MHLH project office.
- CT146. There are no FS concerns at this time.
- CC130J. There are no FS concerns at this time.
- CU170. There are no FS concerns at this time. This fleet is no longer operated.
- SZ23. There are no FS concerns at this time. There are nine open PM for glider FS investigations.
- Air Cadet Glider Program Tow Planes. There are no open PMs from tow aircraft FS investigations.

3.3.4 Aircrew Life Support Equipment (ALSE).

The number of occurrences related to survival and safety equipment has increased from 160 in 2010 to 184 in 2011. The rate also increased to 13.6, although the rate is within one SD, we are at the highest level in the past 11 years. (Graph 14).



Graph 14 - ALSE Occurrence Volume and Rate

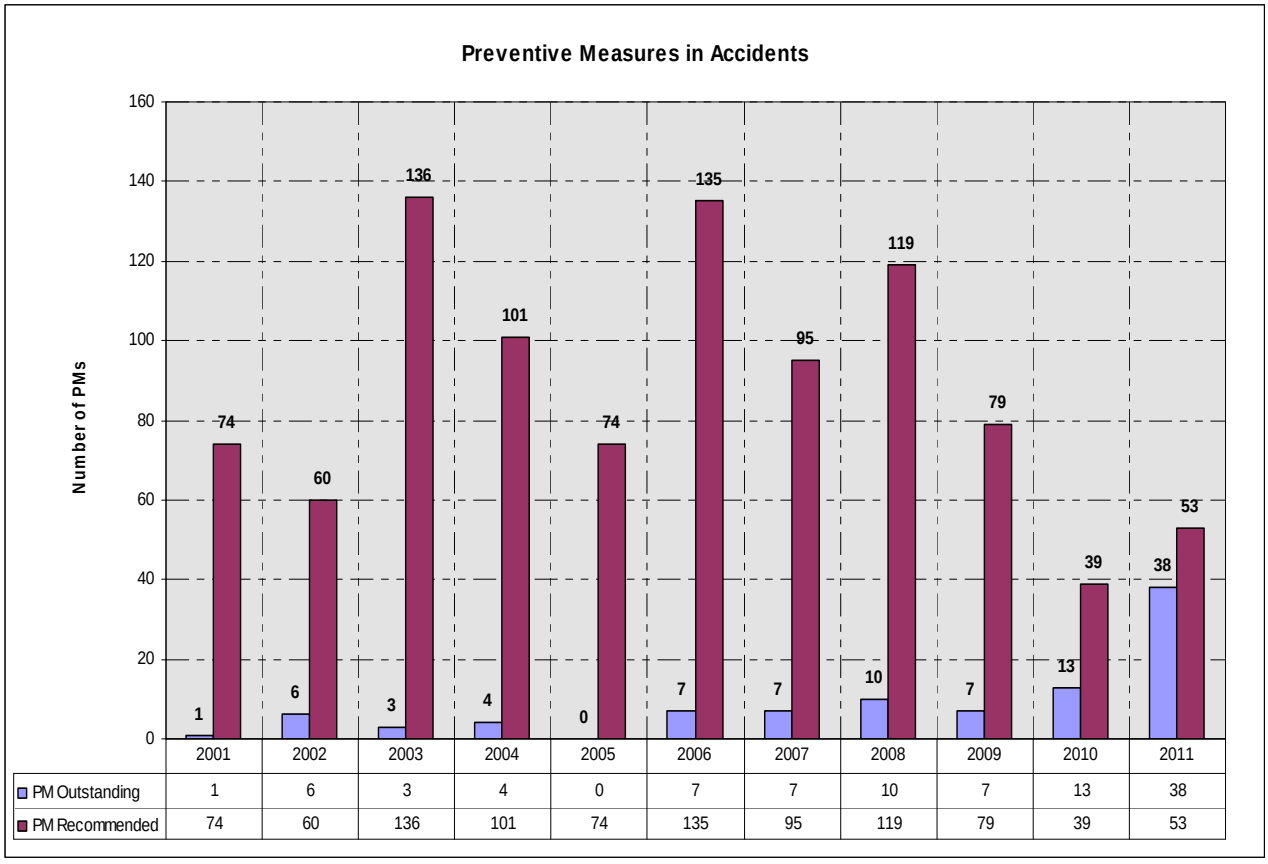
	10	01-10 Mean	01-10 SD	11	D
ALSE RATES	12.0	12.2	1.5	13.6	0.9

Table 18 - ALSE Occurrence Rates

3.3.5 Preventive Measures (PM)

3.3.5.1 Open PMs from Accident Investigations

The development of effective PMs through FS investigations and their timely staffing/implementation by the chain of command is critical to an effective prevention program. Improvements to the staffing of PMs in terms of time to implement and record management of measures taken or decisions made have reduced the number of outstanding PMs. Still, some 28 PMs recommended remain outstanding from 2007 or earlier. This value is slightly lower compared to last years report. It is believed that the PM tracking process is helping the CoC process the proposed measures and prevent reoccurrence.

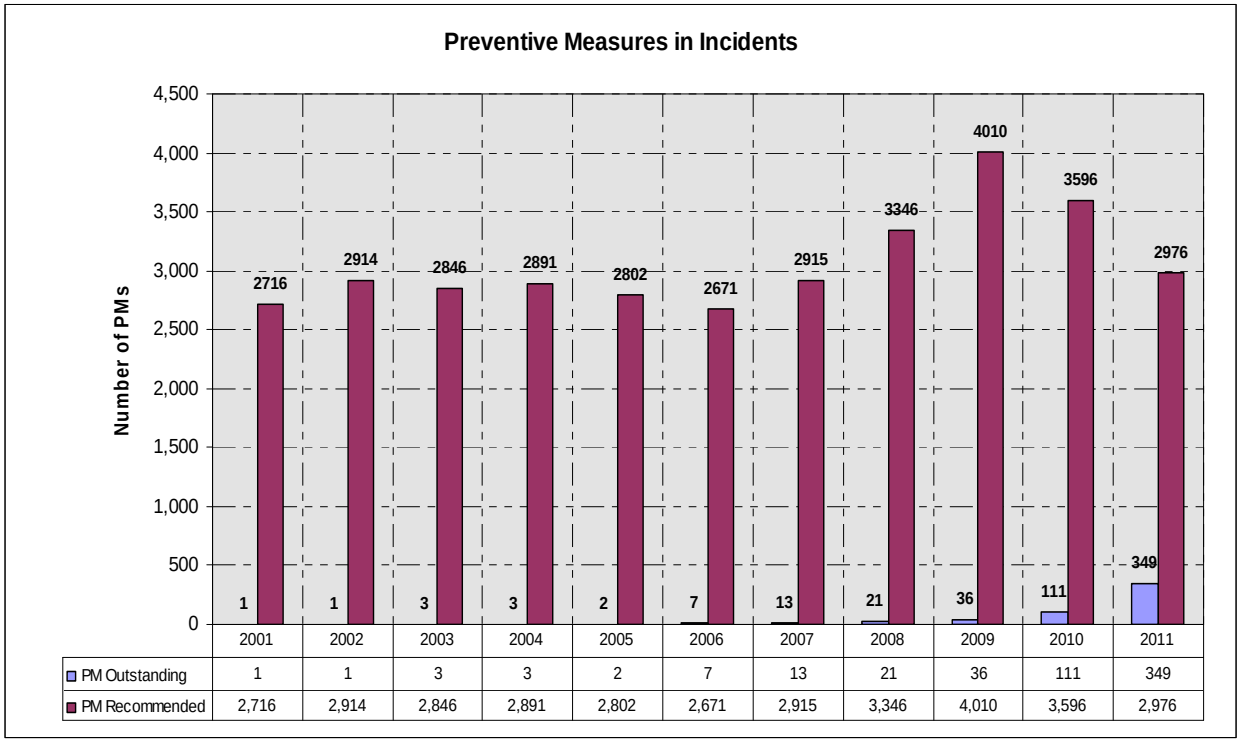


	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
PM Outstanding	1	6	3	4	0	7	7	10	7	13	38
PM Recommended	74	60	136	101	74	135	95	119	79	39	53

Graph 15 - Outstanding and Recommended Preventive Measures from Accidents

3.3.5.2 PM from Incident Investigations

Graph 16 provides the breakdown of PMs for all classes of investigation except Accidents. Note that as of 31 Dec 11, several investigations were not completed and further PMs may be proposed as a result of investigation activities. 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 51 PMs recommended remain outstanding from 2008 and earlier. This value is slightly lower compared to last years report.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
PM Outstanding	1	1	3	3	2	7	13	21	36	111	349
PM Recommended	2,716	2,914	2,846	2,891	2,802	2,671	2,915	3,346	4,010	3,596	2,976

Graph 16 - Outstanding and Recommended Preventive Measures from Incidents

4. STATISTICAL METHODOLOGIES

4.1 COEFFICIENT OF DEVIATION VALUE (D)

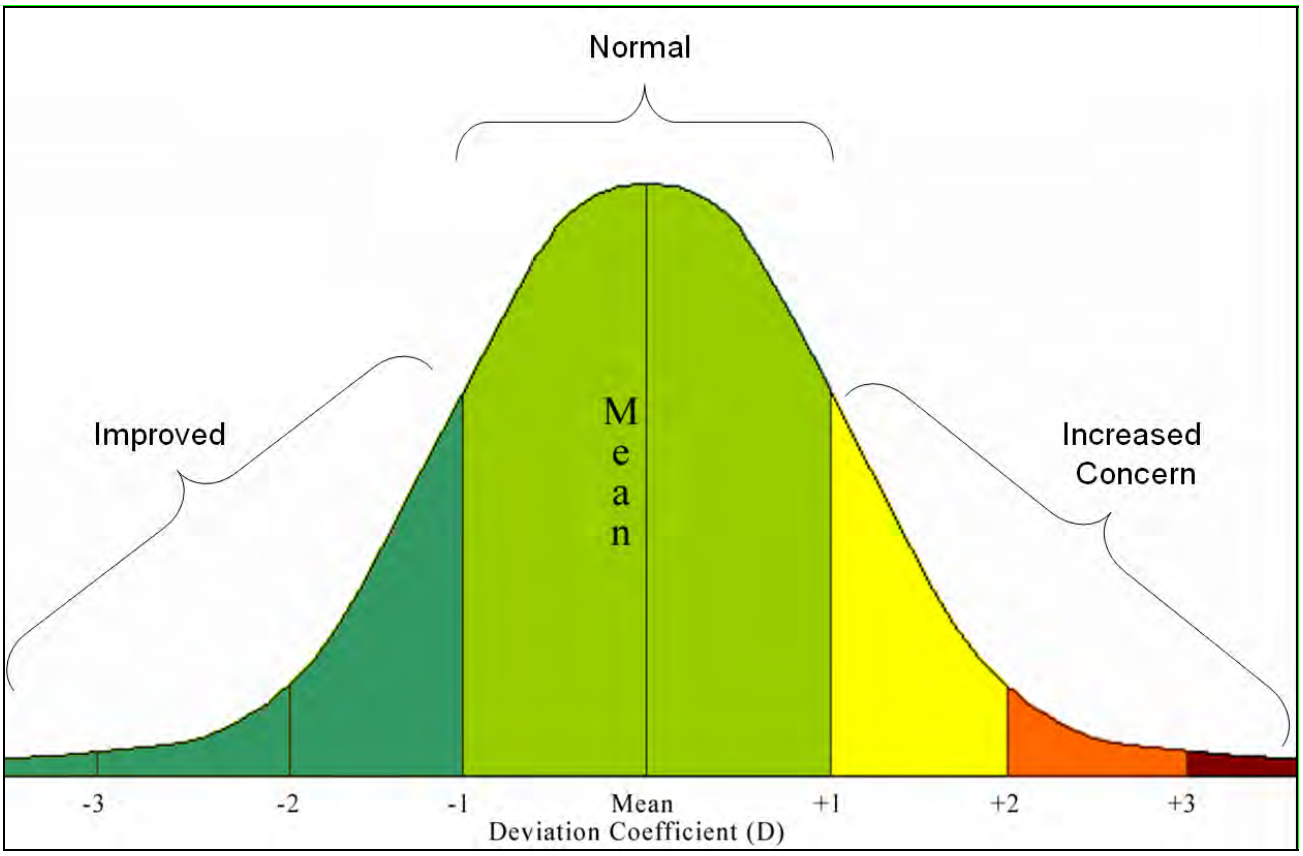
Data values are typically distributed on either side of the mean value. The DFS Statistician measured how far the values are from mean in order to provide an indication of how standard (within a usual range), or alternatively how abnormal (outside of usual range) the value may be, expressed as D. D is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

D = (Value of the current year - Mean [Previous 10 years]) / Standard Deviation (SD)

If the current year D value is between ($-1<D\leq1$) the mean of previous periods (5-year, 10-year period), it is colour coded light green, and would not be of concern. Any value below ($D<-1$) is considered an improvement is coloured dark green 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 ($D>3$), 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).

The positive and negative coefficient is determined in accordance to the data set being measured. For example, an increase in reported occurrences is normally considered positive while an increase in accidents is considered negative. Other D changes may require in-depth analysis to identify contributing factors in order to establish the positive or negative nature.

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



Graph 17 – Mean, SD and D Representation

4.2 DATASETS

Data was extracted from FSOMS as of 31 Jan 11. Flying hours were provided to DFS by DGAEPM

4.3 RATE CALCULATIONS

All reported rates are per 10,000 flying hours, except for Cause Factors and HFACS data, which depicts a rate per 1000 occurrences. Ideally, the HFACS 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 for future 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 (removed form service 2011)
	CH149	Cormorant
Patrol	CP140	Aurora
Trainers	CT102	Astra
	CT111	Slingsby (removed from service in 2006)
	CT114	Tutor
	CT133	Silver Star (removed from service in 2005)
	CT142	Dash-8
	CT145	King Air
	CT146	Outlaw
	CT155	Hawk
	CT156	Harvard II
Transport	CC115	Buffalo
	CC130	Hercules
	CC130J	Hercules
	CC138	Twin Otter
	CT142	Dash-8
	CC144	Challenger
	CC150	Polaris (Airbus 310)
	CC177	Globemaster III

FAMILY	CODE	DESCRIPTION
UAV	CU161	Sperwer (removed from service in 2010)
	CU170	Heron (removed from service in 2011)

Table 19 - 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; and
- 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; and

- 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 Safety of Flight Compromise Level (SFCL)

The SFCL is categorized with a qualifier that describes the level to which safety margins were compromised during an occurrence. The SFCL is defined as follows:

- Extreme: an occurrence where the outcome has been or could have been catastrophic and may have resulted in loss of life or the aircraft;
- High: an occurrence where the outcome has resulted or could have resulted in very serious injury or very serious damage to the aircraft;
- Medium: an occurrence where the outcome has resulted or could have resulted in serious injury or serious damage to the aircraft; and
- Low: an occurrence where the outcome has resulted or could have resulted in minor injury or minor damage to the aircraft.

5.2.4 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.

5.2.4.1 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).

5.2.4.2 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.

5.2.5 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; and
- 'E': Nil ADL and no injury.

5.2.6 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.

5.2.7 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.

5.2.8 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.

5.2.9 Enhanced SR (ESR)

The ESR is to be used for occurrences that are sufficiently 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.

5.2.10 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 PMs. 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 unclassified and be released to the public via the DFS Internet site and internally to the Department on the Intranet site.

5.2.11 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.

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

5.2.13 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.

5.2.14 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.