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2012
Annual Report on Flight Safety

Canada

DIRECTOR COMMENTS

This is the 8th 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 2012.

FS witnessed continued challenges this year due to personnel shortages at the supervisory level. The FS Program bears the signs associated with overdue investigations reports and the impact of increased workload on staff at the wing and squadron levels. The number of reported occurrences (3236) and the rate (247.2/10000 hours) represent an increase when compared to the previous year's data. The Program needs to remain focussed on core activities: investigate occurrences, recommend preventive measures (PMs) and monitor their implementation and effectiveness. In these processes, the responsible FS officers shall ensure that lessons learned are captured and published in order to prevent accidental loss of personnel and critical resources.

The 2012 DFS briefing focused on the importance of proper supervision and communication. With the decrease of experience levels throughout the RCAF, both in the air and on the ground, supervisors at all levels must remain vigilant to identify hazards early and to mitigate impact. Following in the same vein, with the forecasted attrition of senior ranks of both officers and NCMs, proper communication and passage of critical knowledge is paramount. Key FS issues were reported back to the Chief of the Air Force for awareness and action as necessary

The Program has continued to improve, with many important initiatives started or completed in 2012. First, the Human Factors Analysis and Classification System (HFACS) model used to classify FS Personnel cause factors was comprehensively reviewed by DFS. A proposal to modify the taxonomy while improving usability was developed and briefed to the FS Team. When implemented later this year, the changes will facilitate investigator consistency in the assignment of cause factors for similar circumstances. These needed changes will be promulgated in change 7 to A-GA-135-001/AA-001 *Flight Safety for the Canadian Forces*. Second, a collaborative project with the Information Management Gp is underway to upgrade the current Flight Safety Occurrence Management System (FSOMS) to a future Flight Safety Information Management System (FSIMS), providing a next-generation statistical repository and analysis tool. Third, the FS Course taught by 1 Cdn Air Div staff was further enhanced by the production of an improved qualification standard and course enhancements.

In the last year, two points were observed from an analysis of the 2012 FS data. First, overdue occurrence reports continued to hinder the processing of effective PMs. As of February 2012, the average completion time for FS reports was 65 days (twice the expected time). As of the date of this report, 17.9% of reports remained incomplete for 2012. The FS team will explore ways to streamline the review process to reduce overdue reports. This is critical since the recommended PMs and their timely staffing by the chain of command is key to an effective FS Program. Second, the number of near mid-air collisions in training areas continued to increase, despite efforts to reduce them. This was noted in last year's report but limited progress was achieved in resolving the issue, therefore near mid-air collisions continue to be of concern. A renewed effort is required before an accident occurs.

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

EXECUTIVE SUMMARY

This report provides a synopsis of the activities carried out in 2012 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 eight investigations and closed 12. The DFS investigations were for seven CF accidents (one category 'A', two category 'B', and four category 'C') and one Air Cadet accident (category 'B') involving two aircraft.

Aeronautics Act Amendment. A Bill entitled "*Safeguarding Canada's Seas and Skies Act* – C-57" was introduced in Parliament in March 2013 that includes amendments to the *Aeronautics Act* that establishes the AIA for DND/CF. Bill C-57 also includes amendments to four other acts; however, these acts are not related to DND/CF operations and are primarily in the Minister of Transport's areas of responsibility.

Airworthiness Investigation Manual. The amendment to the A-GA-135-003/AG-00 *Airworthiness Investigation Manual* (AIM) was postponed primarily due to the projected re-write and changes that will be required with the amended *Aeronautics Act*. Pending successful completion of the *Aeronautics Act* amendments, this project will commence and form part of the AIA's governance.

Amendments to A-GA 135-001/AA-001. Amendments 5 and 6 of the A-GA 135-001/AA-001 *Flight Safety for the Canadian Forces* were released respectively on 31 Mar 2012 and 04 Sep 2012. Most of these changes were clerical in nature except to the FS command and control table in Chapter 2 and related text, including land and naval assets as well as contractor FS responsibilities. It also clarified definitions and procedures in relation to aircraft recording devices.

CVR/FDR Working Group. As identified in the 2009 AAB, the implementation policy remains focused at tackling one fleet per year for the next 10 years. Three of four CFTS fleets have installed Alternate Means of Compliance systems. The CT114 *Tutor* project has halted due to new cost predictions found in excess of approved funding. DAR will pursue MP funding for CC115 *Buffalo* and CC138 *Twin Otter* during FY 2014/15. DND is awaiting estimates for the CT155 *Hawk*, and CT156 *Harvard II*. Finally CF188 *Hornet*, CP140 *Aurora* and CH146 *Griffon* upgrade are expected to be included with an estimated life expectancy (ELE) extension funding if such plans are pursued. DFS continues to monitor the situation.

FLIGHT SAFETY PROGRAM

Promotion. DFS presented 41 annual briefings (33 English and eight French) at 26 locations across Canada and at the Canadian Contingent at Geilenkirchen, CDLS (London) and SHAPE HQ Belgium. The briefings were attended by approximately 7400 personnel. DFS personally

met with over 75 Commanding Officers and their Squadron Warrant Officers as well as visited seven air traffic control towers. Concurrently, the Directorate published four issues of *Flight Comment* magazine and four issues of the electronic FS newsletter *Debriefing*. There were two FS Flash messages released during 2012. A decision was made to discontinue the production of the *On Target* magazine in favour of producing the fourth edition of *Flight Comment* which could focus on a single topic if necessary. A total of 25 FS award submissions for individuals or groups were considered, resulting in the granting of three *Good Show* and 19 *For Professionalism* awards and five recommendations for a commander's commendation.

Surveys. DFS conducted three FS surveys at contracted service provider sites as part of the DFS contracted service provider visit program. The 1 Cdn Air Div FS staff conducted surveys of seven wings and 3 CFFTS in addition to a FS SAV at 1 Wing. With over 50 visits to Sqns, supporting units, and contracted service providers, the FS staff provided 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.

Training. A total of five FS courses (FSC) were conducted by 1 Cdn Air Div FS staff. They qualified 162 personnel, including Air Cadet staff members, civilian contracted service providers, army personnel and DND firefighters. A survey of graduates will be conducted approximately 12 months after completion on the course to assist in tailoring instruction. The Specialty Specification Codes remain to be amended to enable the tracking of these qualifications.

STATISTICS AND DATA ANALYSIS

Flying Hours and Reporting. Compared to 2011, the number of hours flown in the CF has decreased by 13.9%. Personnel reported 3,236 occurrences, of which 54.9% were classified as air occurrences. When compared to last year, the reporting rate increased significantly to a 10 year high of 247.2. The increase is, however, proportionally higher in the No Damage/No Injury category.

Occurrence Breakdown. The CF had a fortuitous FS record for 2012. Major and minor injuries decreased (no fatalities, no aircraft destroyed, 3 serious, and 49 minor injuries). The air accident rate for the CF also decreased significantly to 0.43 and is below the 10-year mean of 0.64. This was attributable to one category 'A' (CC130 *Hercules*), one category 'B' (CH146 *Griffon*) and two category 'C' (one CH146 *Griffon*, one CC138 *Twin Otter*) accidents.

Personnel Cause Factor. The Human Factors Analysis and Classification System (HFACS) model was reviewed. The taxonomy was modified significantly to provide investigators consistency when assigning cause factors for similar circumstances. It is definitely more user friendly. These long-awaited changes will be promulgated in change 7 to A-GA-135-001/AA-001 amendment to be published in the summer of 2013.

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. Last year, the FS Program saw a large number of overdue occurrence reports (509 of 3149). This was initially thought to be related to when the annual report queries were conducted in Mar 12. This year, the queries were specifically delayed in order to provide the opportunity for units and wings to complete their occurrence reports. As of 24 May, 18% of the 2012 occurrence reports were still overdue (575 of the 3236). As well, there were 122 additional overdue occurrences related to years prior to 2102. This issue must be addressed under a separate venue.

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1. AIRWORTHINESS PROGRAM

1.1 AERONAUTICS ACT UPDATE (2011-2012)

A Bill entitled "*Safeguarding Canada's Seas and Skies Act* – C-57", was introduced in Parliament in March 2013 that includes amendments to the *Aeronautics Act* that establishes the Airworthiness Investigative Authority (AIA) for DND/CF. Powers bestowed by amendments within the proposed Act will enable the AIA's delegated investigators to conduct appropriate investigations of matters concerning aviation safety, particularly those situations involving civilians. It also establishes privilege with respect to on-board recordings, communication records and certain statements, and permits, among other things, access to an on-board recording if certain criteria are met. Bill C-57 also includes amendments to four other acts; however, these acts are not related to DND/CF operations and are primarily in the Minister of Transport's areas of responsibility.

1.2 AIRWORTHINESS INVESTIGATIVE MANUAL

Amendment to the A-GA-135-003/AG-00 *Airworthiness Investigation Manual* (AIM) was postponed primarily due to the projected re-write and changes, which will be required with amendments to the *Aeronautic Act*. Pending successful completion of the AA amendments, this project will commence as soon as possible and be part of the governance and documentation changes this event will prompt. 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 three FS surveys at contracted service provider sites (Magellan Aerospace (Orenda) in Mississauga, ON; Vector Aerospace in Richmond, BC; and IMP Cormorant Support Center in Halifax and Greenwood, NS) as part of the DFS' contracted service provider visit program. 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. 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 Wing, 443 Sqn, and 3CFFTS. A FS SAV to 1 Wing was also 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 Policy Implementation

As identified in the 2009 AAB, the implementation policy remains focused at tackling one fleet per year for the next 10 years. The three of four Contracted Flying Training and Support (CFTS) fleets (CT145 *King Air*, CT102 *Grob*, and CH139 *Jet Ranger*) have installed Alternate Means of Compliance systems. Although the CT114 *Tutor* received approval for a Minor Project (MP), the project has halted due to new cost predictions found in excess of approved funding. Director Aerospace Requirements (DAR) will pursue MP funding for CC115 *Buffalo* and CC138 *Twin Otter* during FY 2014/15. Although D Air Contracted Force Generation (CFG) continues to issue Requests for Proposals (RFPs) or Contract Change Orders to contract for CVR/FDR services; DND is still awaiting estimates for the CT155 *Hawk*, and CT156 *Harvard II*. Finally CF188 *Hornet*, CP140 *Aurora* and CH146 *Griffon* upgrades are expected to be included with estimated life expectancy (ELE) extension funding if such plans are pursued. DFS continues to monitor the situation.

1.4.2 FSIMS Development

The Safety Information Management System (SIMS) project is progressing according to schedule. Development is providing the opportunity to address deficiencies that were previously impossible to remedy due to obsolete software language. Five of the 12 planned development phases have been completed. Delivery of FSIMS is expected by the late spring of 2014. The Wing Periodic Report (WPR) introduced last year has been adjusted to include wing and squadron level information and the frequency adjusted to monthly. The Bi-weekly and WPR are now produced in a bilingual form.

1.5 INVESTIGATIONS

1.5.1 DFS Investigation Summary

During the calendar year, the AIA initiated eight investigations and closed 12. The DFS investigations were for seven accidents (one category 'A', two category 'B', and four category 'C'). These figures include one Air Cadet (categorized non-CF) investigation for a two aircraft accident (category 'B').

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
CLASS I INVESTIGATIONS						
1	22 Feb 12	A	Very serious	Minor	Hercules	Hydraulic Fire
CLASS II INVESTIGATIONS						
2	13 Feb 12	B	Very serious	Nil	Griffon	Wire strike
3	12 May 12	E	Nil	Nil	Civilian Beech	Runway incursion

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
4	06 Jul 12	C	Serious	Minor	Griffon	Hard landing
5	30 Jun 12	C	Serious	Nil	Hercules	Jack collapse
6	14 Aug 12	B	Very serious	Serious	Glider	Flipped in high winds
7	23 Aug 12	C	Serious	Nil	Twin Otter	Sheared nose gear
8	16 Nov 12	C	Serious	Nil	Cormorant	Sheared MGB Bolts

Table 1 – List of 2012 AIA Initiated Investigations

1.5.2 Investigation Details

1.5.2.1 23 Feb 12, CC130342, Accident, Category 'A', NAS Key West, FL

The accident occurred during a touch and go at Naval Air Station Key West. During the take-off just prior to the aircraft becoming airborne, the Loadmaster, who was 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. He then unbuckled his harness and was reaching for the fire extinguisher when an expansive orange fireball erupted, causing him to protect his head with his jacket. Once the fireball receded, he 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. With sufficient runway remaining, the Flying Pilot landed straight ahead and aggressively stopped the aircraft while the Non-Flying Pilot notified ATC. Once the engines were shut down, all nine crewmembers quickly egressed and moved upwind of the aircraft. Crash, Fire, and Rescue services responded and expeditiously extinguished the fire. The aircraft was extensively damaged and one crewmember received a minor injury during egress.

The Flight Data and Cockpit Voice Recorders were recovered along with many parts related to the auxiliary hydraulic system, located in the aircraft's rear. 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.

1.5.2.2 13 Feb 12, CH146453, Accident, Category 'B', Yellowknife, NWT

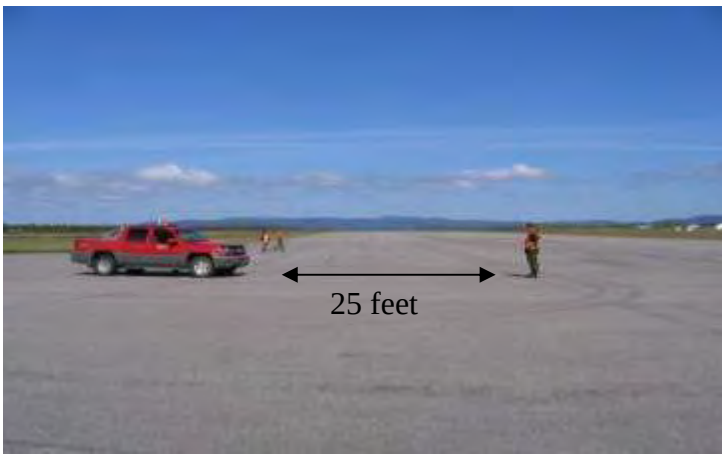
While supporting Exercise ARCTIC RAM, *Griffon* CH146453 was conducting a night familiarization in the approved Low Flying Area. On the return to CYZF, while practicing low level flying, the aircraft overflew a lake and cut three high-tension power lines with the wire strike protection system at 54 feet (ft) above ground level (AGL) approximately 6.5 nautical miles (NM) north-west of CYZF disrupting electrical power to the city of Yellowknife. In the ensuing post-impact confusion, the crew then allowed the helicopter to descend to approximately 6 to 21 ft AGL before they conducted a climbing 180-degree turn, inadvertently overflying the same power line again. The helicopter returned to CYZF from the north, overflew the airfield, hover-taxied to the ramp and shut down. The aircraft sustained B category damage.

Without the use of a checklist during a poor mission brief, the investigation found that the crew was not adequately prepared for this flight. No map or route reconnaissance of the area was completed; however, they still conducted unplanned low level flying in an unfamiliar area without reference to a map. After having completed their training, on the return to CYZF the crew chose to fly north of their intended route to conduct this low level flying training. Their perception of this mission as a low risk/low threat flight, their expectations regarding the distant location and large size of the transmission line, and their low state of arousal led to a reduced vigilance that contributed to a breakdown of visual scan. Due to this breakdown, combined with the lack of familiarity with the northerly flight path and a distracting discussion on simulated emergency considerations, the crew experienced geographical disorientation that precluded them from manoeuvring in time to see and avoid the transmission line.

Post-accident, the exercise low level flying altitude was raised to 500' AGL, errors with maps were corrected and the Commander 1 Wing provided direction on proper pre-flight planning, reconnaissance procedures, wire strike avoidance training, flight authorization procedures and supervision of inexperienced crews.

Safety recommendations include reviewing directions to Flight Authorizing Officers and to crews in the event of aircraft damage sustained in flight. Defence Research Development Canada was asked to review aircrew post-deployment/post-high operational tempo risk factors and human performance training tools to develop risk mitigation and coping strategies for RCAF implementation. Other recommendations include the implementation of a mission acceptance and authorization process for all CF fleets, inspection procedures of crew life support equipment, guidance to Flight Surgeons when dealing with civilian hospitals and post-occurrence testing of night vision goggles.

1.5.2.3 12 May 12, Beech 1900, Incident, Category 'E', Goose Bay, NL



A civilian-operated Beech 1900 aircraft was landing on runway 34 at CYYR. The aircraft was in the landing flare when a vehicle entered runway 34 at the intersection of runway 26 and then stopped. The aircraft passed within an estimated 25 feet of the vehicle but continued its landing roll-out without further incident. A Flight Safety Investigation, coordinated with the Transportation Safety Board, was convened to investigate the incident.

The investigation determined that the ground controller (GC) did not use the term "Negative" to issue a restriction to the vehicle operator's (VO) request to cross the runway and that the VO did not actively scan the runway for potential traffic conflicts prior to proceeding onto the active runway. Additionally, the VO's misinterpretation of the GC's clearance was exacerbated by the VO's expectancy to hear the term "Proceed" or "Negative." Upon hearing "Proceed," the VO erroneously assumed that he was cleared to his requested destination. It was further determined that non-standard phraseology was used by CYYR Air Traffic Control (ATC) and that 1 Cdn Air Div publications did not define currency or specify a validity period for the Ramp Defensive Driving Course (DDC) qualification.

Safety recommendations included the publication of a Flight Safety Debriefing article summarizing CF runway incursion trends within the past ten years. 1 Cdn Air Div reviewed the Civil Aviation Daily Occurrence Reporting System filing policy, clarified the timelines for the Ramp DDC validity period, and made the revamped Ramp DDC program accessible through their website. It is further recommended that 1 Cdn Air Div formally publish the Ramp DDC currency and validity requirements and review the content of the Ramp DDC program and ATC National Professional Knowledge exam. Recommendations specific to CYYR included ensuring ATC terminology and phraseology is conducted according to the ATC Manual of Operations, relocating the GC speaker in the control tower, and imposing the successful completion of a written and practical airfield driving test for the local Ramp DDC qualification.

1.5.2.4 06 Jul 12, CH146437, Accident, Category 'C', CFB Nameo, AB

On completion of a Basic Handling and Emergency training flight, *Griffon* CH146437 was attempting to conduct a descending, decelerating transition to the hover to a spot south of the fuel pumps with a right hand turn to a northerly heading. During this final turn, the aircraft began to sink rapidly; the First Officer (FO) raised the collective to a position which he believed to correspond with maximum mast torque (QM) but the aircraft continued to descend. Just after the FO levelled the aircraft, *Griffon* CH146437 landed hard and sustained C category damage. The Flight Engineer suffered minor injuries.

The investigation focused on power management, aircrew flying rates, aircrew fault analysis, aircrew factors, crew pairing and mentorship.

The investigation concluded that the crew entered into a settling with power situation from which they did not recover. An incorrect wind advisory by the Advisory Controller, an inadequate wind appreciation by the crew and the attempt of a descending, decelerating transition to the hover with an inadequate assessment of closure rates were factors in this accident. A significant contributing factor included poor power management; the blades were not loaded during the final approach, both pilots inaccurately assessed the collective position and they did not increase it to its maximum travel. Lastly, the aircraft captain (AC) did not recognize the point at which he needed to provide assistance to the FO. Collective travel, corresponding QM and rotor RPM were available to slow the rate of descent and potentially prevent the accident.

The investigation team also found that the low yearly flying rate amongst 1 Wing pilots could hamper skill development, delay progress in the pilot upgrade program, and degrade experience levels. Several ACs within 1 Wing have not received any formal fault analysis and debrief training and may be ill-prepared to mentor and assist junior FOs. The AC's expectancy and complacency during the approach and the FO's lack of consistent crew pairing during the early stage of his rotary wing flying career were also safety concerns.

Post-accident safety actions taken by the unit Commanding Officer included amendments to his flight authorization process, the implementation of a unit mentorship program and modifications to local arrival procedures. Recommendations included addressing the gap in Fault Analysis and Debrief training, developing a Wing mentorship program and ensuring Air Traffic Control (ATC) wind notification procedures are followed as per the ATC Manual of Operations. Finally, a Record of Airworthiness Risk Management should be created to address the low aircrew experience levels within 1 Wing.

1.5.2.5 30 Jun 12, CC130617, Accident, Category 'C', CFB Trenton, ON

Early in the morning of 1 Jul 12 (0212Z), contracted personnel working on a CC150 *Airbu*s in 10 Hangar heard a loud noise and noticed that the Hercules in the adjacent Bay 5 was rocking from side to side. Upon closer inspection, they noted that the left main wing jack had collapsed and damaged the left main landing gear door. The right main wing jack had come off its jacking pad and penetrated approximately 12 to 18 inches into the wing. No fuel cells were ruptured. The right nose jack also came off its jacking fitting and torsional deformation of the airframe was noted on the aircraft fuselage skin near the left nose jacking position.

The aircraft had been on jacks for four days prior to the occurrence. There were no injuries as no one was working on the aircraft at the time. The preliminary damage category is 'C', although the aircraft is still undergoing damage assessment by the OEM. The two main wing jacks were sent to QETE for further analysis and testing. The investigation is focusing on the jack assembly's maintenance, configuration and failure mechanism.

1.5.2.6 14 Aug 12, CGFMC/CGQMH, Accident, Category 'B', Netook, AB

Region Gliding School (Prairie) was conducting Air Cadet glider familiarization flights from the Netook airfield. On the day of the occurrence, flights were commencing from the button of runway 32, approximately one kilometre south of the hangar. The hangar was the only permanent location on the airfield to secure the gliders.

When the weather showed signs of deteriorating, the Site Commander decided to winch launch and recover each glider near the hangar to substantially reduce the towing distance to the hangar and to expeditiously secure the gliders. While attempting to launch the first glider, the launch rope broke. A team was dispatched to repair the rope; however, it began to rain and the plan to conduct launches was abandoned. The gliders were secured to the ground by one flight-line tie-down at each right wing strut and another at each glider's tail in order to wait out the rain. Each flight-line tie-down was screwed into the ground about six inches.

Over the next 40 minutes, the rain increased and the wind became gusty. To help stabilize the gliders, personnel entered the cockpit of each glider while others held onto the wings and tail. An attempt was made to install another flight-line tie-down to the left wing strut of each glider; however, a strong gust of wind sent the lead glider (C-GFMC) airborne, pulling the flight-line tie-downs out of the ground. C-GFMC nosed up and rolled right while drifting downwind. It impacted the ground in an inverted attitude, 80 feet from its initial location before continuing to drift an additional 100 feet. The occupant of the glider was injured when he was ejected from the cockpit and during this process two others were injured.

When the first glider went airborne, the occupant of the second glider (C-FQMH) climbed out of the cockpit and minutes later; this glider also became airborne in a gust of wind. C-FQMH impacted the ground in an inverted attitude 75 feet from its initial location before continuing to drift an additional 65 feet.

The three injured personnel were transported to hospital. They were treated for minor injuries and released later that evening. Both gliders sustained very serious damage. The investigation is focusing on weather factors, tie-down equipment and other procedures associated with securing the gliders in high wind conditions.

1.5.2.7 23 Aug 12, CC138804, Accident, Category 'C', Near Inuvik, NT

The *Twin Otter* aircraft with a crew of three and three military passengers were conducting austere airfield training on the tundra (near Horn Lake) southwest of Inuvik, NT. Austere airfields consist of semi-prepared runways and unprepared surfaces such as sandbars, shorelines, eskers and plateaus.

In order to conduct an austere airfield landing, the crew flies a number of low passes to evaluate the suitability of the site and then a "drag" manoeuvre is flown to assess the landing area's surface condition. During a drag manoeuvre the main wheels lightly touch the landing surface while a speed of 50 to 60 knots is maintained until reaching the end of the landing area where a normal takeoff is completed.

At the site of the occurrence, the drag manoeuvre indicated the terrain was rough but suitable, so the crew conducted a full stop landing. An inspection of the landing area following the stop showed that the surface was covered with tundra hummocks and that the wheels had sunk into gaps between individual hummocks. Tundra hummocks are small mounds of soil and vegetation and are a feature of the tundra related to the presence of permafrost.

During the takeoff attempt, the aircraft was stuck and would not move under the application of full power. The crew shutdown the aircraft, dug out the hummocks in front of each wheel and

inserted plywood ramps to facilitate rolling the aircraft over the top of the hummocks for takeoff.

This procedure was effective; however, during the takeoff roll as the aircraft was approaching flying speed, the nose wheel sunk into soft ground and the nose landing gear strut sheared off just above the wheel yoke. The nose then dropped to the ground and the aircraft skidded forward as the crew aborted the takeoff. The investigation determined the aircraft had sustained serious damage and that there were no injuries.

The investigation is focusing on the structural integrity of the nose landing gear strut, the austere airfield operating procedures and the austere airfield training program.

1.5.2.8 16 Nov 12, CH149910, Accident, Category 'C', CFB Greenwood, NS

A technician was carrying out a torque check and nut replacement of the bolted connection between the Main Gearbox (MGB) upper case and main case of a *Cormorant* aircraft when a lock-ring stud failed in overload. Additionally, several other lock-ring studs at the bolted connection had likely been overtorqued and, consequently, the MGB was declared unserviceable and returned to the Original Equipment Manufacturer (OEM) for repair. The torque check was part of an on-going recurring inspection detailed in an OEM-issued Mandatory Service Bulletin and was being conducted on aircraft CH149910 during a periodic 300 hour inspection.

The preliminary investigation determined that a number of errors contributed to the lock-ring stud failure, including misidentification of the MGB main case and inadvertent confusion between metric and imperial torque units. The investigation also revealed that similar errors had occurred on other MGBs. The continuing investigation will focus on human factors and the interrelationships between engineering and maintenance.

The ongoing investigation is focussing on crew coordination and training procedures

1.5.3 Investigation Report Status

1.5.3.1 Table 2 outlines the status of ongoing investigations as of 31 Dec 2012. 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, waiting on 1 Wing comments
08 May 09	SAR Tech	SAR tech fouled parachute	Draft for comment with PDI
27 Jul 09	CH149910	Main Gear Box casing crack	Draft for comment rewrite
18 Nov 10	CF118789	Crash on approach	Draft for comments with PDI
19 Apr 11	CH146489	SAR Tech hard landing	Epilogue sent for translation
15 May 11	CH147205	Hard landing and rollover in brownout	Draft for comments being prepared
10 Jun 11	CT155201	Engine failure followed by ejection	Draft for comments due end Sep 13
17 Jun 11	CH146491	Overtorque during night boat hoist	Drafting ESR
27 Oct 11	SAR Tech	SAR Tech fatality during Arctic SAR mission	Draft for comments responses due 9 Apr 13
22 Feb 12	CC130342	Hydraulic fire in-flight	Draft for Comment being prepared
30 Jun 12	CC130617	Jack collapse	Drafting ESR
14 Aug 12	CGFMC/ CGQMH	Gilders upset in high winds	Draft for Comment being prepared
23 Aug 12	CC138804	Nose gear failure during austere T/O	Drafting ESR
16 Nov 12	CH149910	Sheared main gearbox bolts	Draft for Comment being prepared
09 Jan 13	CC130434	SAR Tech injury	Draft for Comment being prepared

Table 2 – Ongoing Investigation Report Status

1.5.3.2 Table 3 outlines the investigations that were closed during 2012.

ACCIDENT DATE	AIRCRAFT	DESCRIPTION	INVESTIGATION CLOSURE DATE
06 Jul 09	CH146434	Crashed on departure in brownout	Epilogue posted 30 Jan 13

17 Nov 09	CF188925	Training round lands app 50 feet from ground personnel	FSIR posted 01 Mar 12
16 Jul 10	Heron 255	UAV hit telephone pole on final and crashed	Epilogue posted 30 Jan 13
05 Aug 10	CH147202	Forced landing and subsequent fire	Epilogue posted 18 Dec 12
18 Dec 10	CH149907	No3 Engine failure	Epilogue posted 29 May 12
23 Feb 11	CH146476	Hard landing in dust ball	Epilogue posted 11 May 12
18 Jun 11	C-FYLP	Injury on landing	Epilogue posted 13 Aug 12
23 Jul 10	CF118738	Air show demonstration 'High Alpha' pass with engine failure	Epilogue posted 11 Dec 12
25 Jul 11	C-GSSD	Scout nose-over	Epilogue posted 23 May 12
13 Feb 12	CH146453	Wire strike	Epilogue posted 01 Feb 13
12 May 12	CIVILIAN BEECH	Runway incursion at Goose Bay	Epilogue posted 18 Jan 13
06 Jul 12	CH146437	Hard landing	Epilogue posted 18 Jan 13

Table 3 – Closed Investigation Report Status

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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 7400 personnel. DFS met with over 75 Commanding Officers and their Squadron Warrant Officers as well as visited seven air traffic control towers. DFS published four issues of *Flight Comment* magazine; and four issues of the electronic FS newsletter *Debriefing*. There were two FS *Flash* messages released during 2012. Since the readership was uncertain as to the nature of the *On Target* Magazine, it was discontinued in favour of producing an additional Flight Comment that can be dedicated to a single topic if necessary.

2.2 AWARDS

A total of 25 FS award submissions for individuals or groups were considered resulting in the granting of three *Good Show* and 19 *For Professionalism* awards and five recommendations for Commanders Commendations. When compared to the previous reporting period, although there were four fewer award nominations submitted, the total number of awards granted only decreased by two.

2.3 TRAINING

There was a total of five Flight Safety Courses (FSC) conducted by 1 Cdn Air Div FS staff. They qualified 153 personnel, including Air Cadet staff members, civilian contracted service providers, army personnel and DND firefighters. A total of nine people attended the advanced portion of the FSC for a total of 162 personnel trained. A survey of graduates will be conducted approximately 12 months after completion on the course to assist in tailoring instruction. The Specialty Specification Codes require amendment to enable the tracking of these qualifications.

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3. STATISTICS AND TREND ANALYSIS

3.1 GENERAL

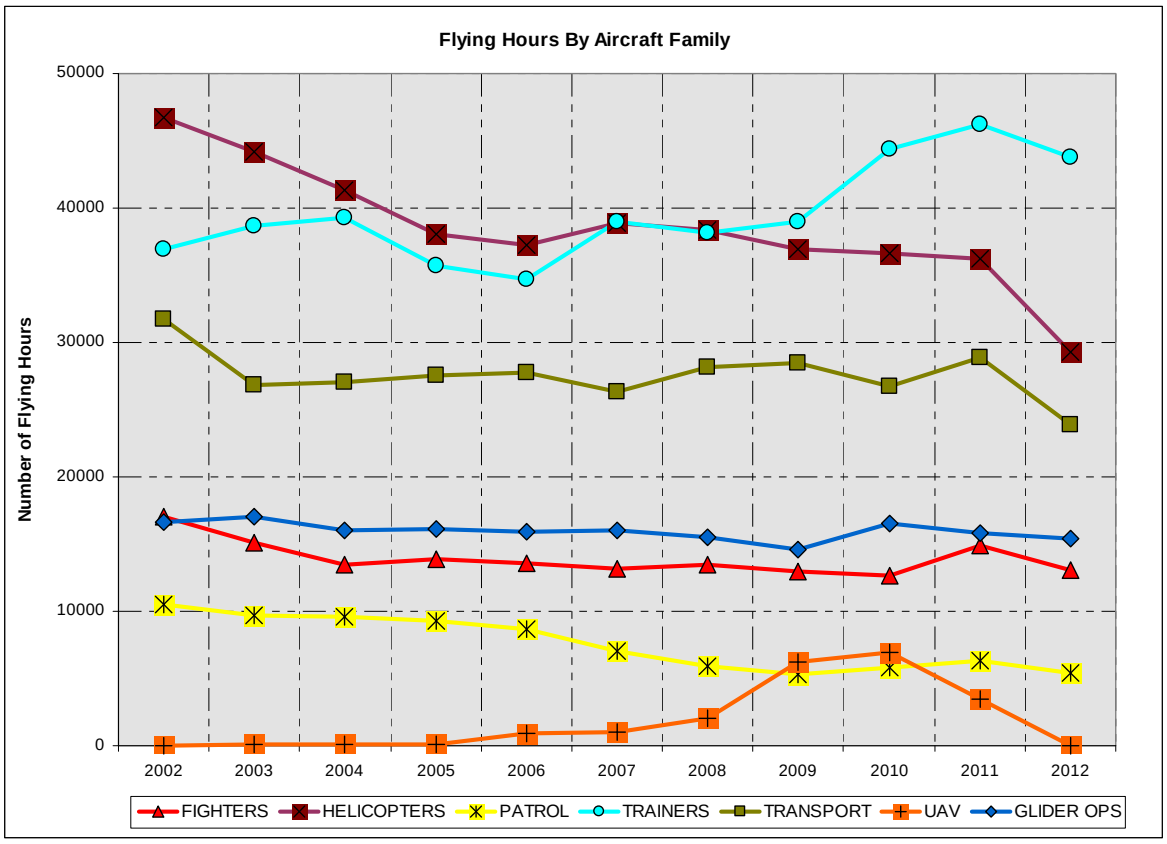
Rates are calculated per 10,000 flying hours, except for cause factors and HFACS data, which is reported per 1000 occurrences. Data is classified according to the level of concern and randomness. The colour code shown below is derived from the difference between the 2011 value and the 10-year mean (unless 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 a significant decrease (13.9%) from 151,944 to 130,886 compared to the previous year. This was due mainly to a decrease to deployed operations support. There was a decrease in flying hours for the fighters (CF188 *Hornet*), all helicopters except the CH149 *Cormorant*, the Transport fleets and cessation of CU170 UAV operations. 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

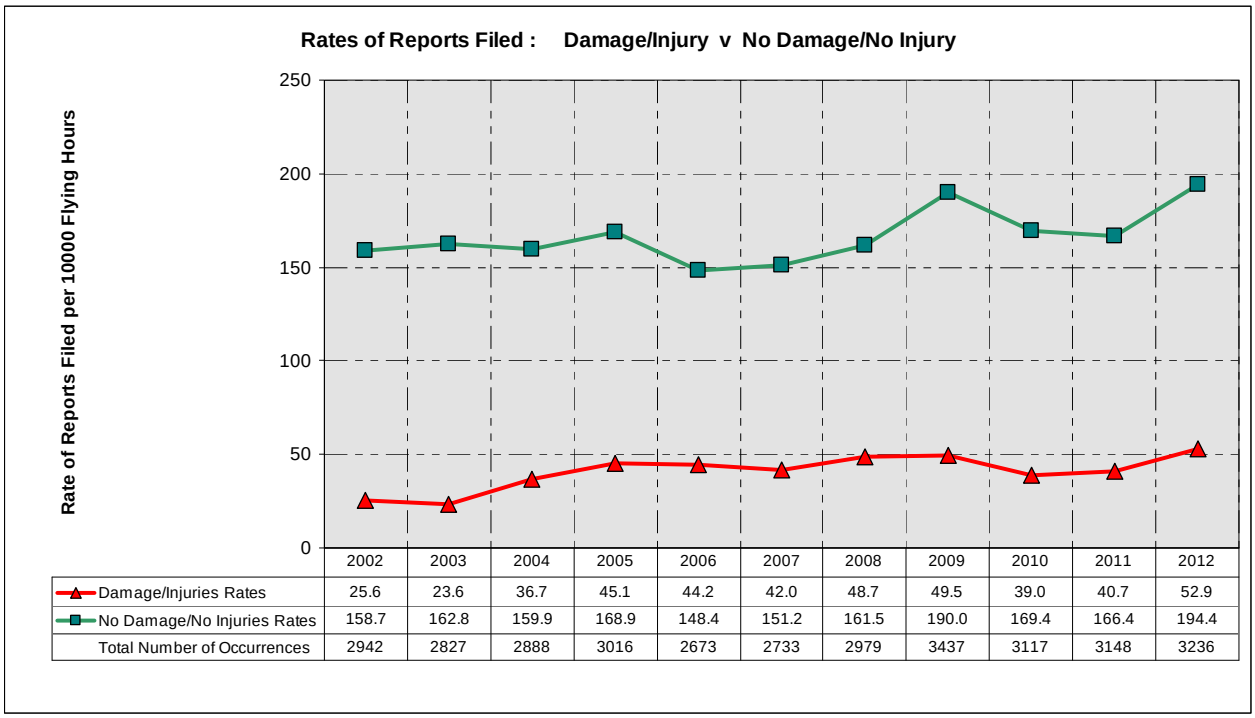
FLYING HOURS	02	03	04	05	06	07	08	09	10	11	12
FIGHTERS	**17004**	**15126**	**13476**	**13836**	**13546**	**13142**	**13497**	**12980**	**12699**	**14885**	**13206**
CF116	68	18	0	0	0	0	0	0	0	0	0
CF188	16936	15108	13476	13836	13546	13142	13497	12980	12699	14885	13206
HELICOPTERS	**46725**	**44212**	**41317**	**38099**	**37270**	**38884**	**38406**	**36958**	**36607**	**36228**	**29331**
CH113	4040	1626	464		0	0	0	0	0	0	0
CH124	10546	8226	8487	6857	6944	7628	7984	7830	7771	8557	7400
CH139	6666	6070	6371	5024	4613	4852	5684	1863	1834	2241	2027
CH146	22277	23384	21426	21632	21150	21465	19661	20332	19100	18495	14267
CH147	0	0	0	0	0	0	4	2058	2743	1605	0
CH149	3196	4906	4568	4586	4563	4939	5073	4875	5159	5330	5637
PATROL	**10554**	**9684**	**9642**	**9324**	**8704**	**7012**	**5952**	**5324**	**5832**	**6369**	**5457**
CP140	10554	9684	9642	9324	8704	7012	5952	5324	5832	6369	5457
TRAINERS	**36973**	**38656**	**39315**	**35744**	**34741**	**39023**	**38210**	**38997**	**44361**	**46261**	**43741**
CT102	0	0	0	0	2118	3805	4898	5817	7049	8052	6596
CT111	3230	2994	4163	3079	0	0	0	0	0		
CT114	4088	3894	3903	3757	4101	3912	3926	3867	3726	3920	3540
CT133	1586	448	336	74	0	0	0	0	0	0	0

FLYING HOURS	02	03	04	05	06	07	08	09	10	11	12
CT142	2304	2328	2446	2660	2760	2483	2059	1931	1866	2139	1645
CT145	3951	4771	5079	3271	2141	3381	3087	3425	3411	3868	3429
CT145A	0	0	0	0	0	0	0	763	1371	1315	1305
CT146	0	0	0	38	93	67	980	2719	3847	4152	4525
CT155	7342	8383	8446	9137	8806	8714	6706	5836	7042	5462	6054
CT156	14474	15838	14942	13728	14722	16661	16554	14639	16049	17353	16647
TRANSPORT	**31708**	**26878**	**27007**	**27599**	**27741**	**26303**	**28191**	**28446**	**26714**	**28885**	**23901**
CC115	2120	2439	1839	2533	2065	1762	1703	1601	1751	1724	1761
CC130	19308	14945	15839	15442	16486	14870	14359	13963	10805	7928	5828
CC130J	0	0	0	0	0	0	0	0	758	4272	5635
CC138	1856	1923	1834	1962	1581	2166	2165	1830	1874	1420	1498
CC144	3157	2812	2979	2815	2706	2445	2712	3095	2815	2731	2736
CC150	5267	4760	4516	4847	4903	4483	4666	4402	4561	4959	2665
CC177	0	0	0	0	0	577	2586	3555	4150	5851	3778
UAV	**0**	**55**	**117**	**141**	**876**	**1031**	**1994**	**6193**	**6889**	**3493**	**0**
CU161	0	55	117	141	876	1031	1725	883	0	0	0
CU170	0	0	0	0	0	0	269	5310	6889	3493	0
CF TOTAL	**142966**	**134612**	**130873**	**124743**	**122878**	**125395**	**126250**	**128898**	**133102**	**136121**	**115456**
GLIDERS	**16662**	**17068**	**16033**	**16149**	**15895**	**16050**	**15487**	**14628**	**16511**	**15823**	**15430**
GRAND TOTAL	**159628**	**151680**	**146906**	**140892**	**138773**	**141445**	**141737**	**143526**	**149613**	**151944**	**130886**

Table 4 – Flying Hours by Aircraft Family and Type

3.2.2 Reporting of Occurrences

From Graph 2, a total of 3236 occurrences were reported; of these 54.9% were Air occurrences and the remaining 45.1% were Ground occurrences. This is an increase in the reported occurrences compared to the previous year (3148) and remains above the 10-year mean value of 2976. The occurrence-reporting rate also increased significantly to a 10 year high of 247.23 compared to 207.87 in 2011. Although the occurrence rate has increased, the increase is proportionally higher in the No Damage/No Injury category.



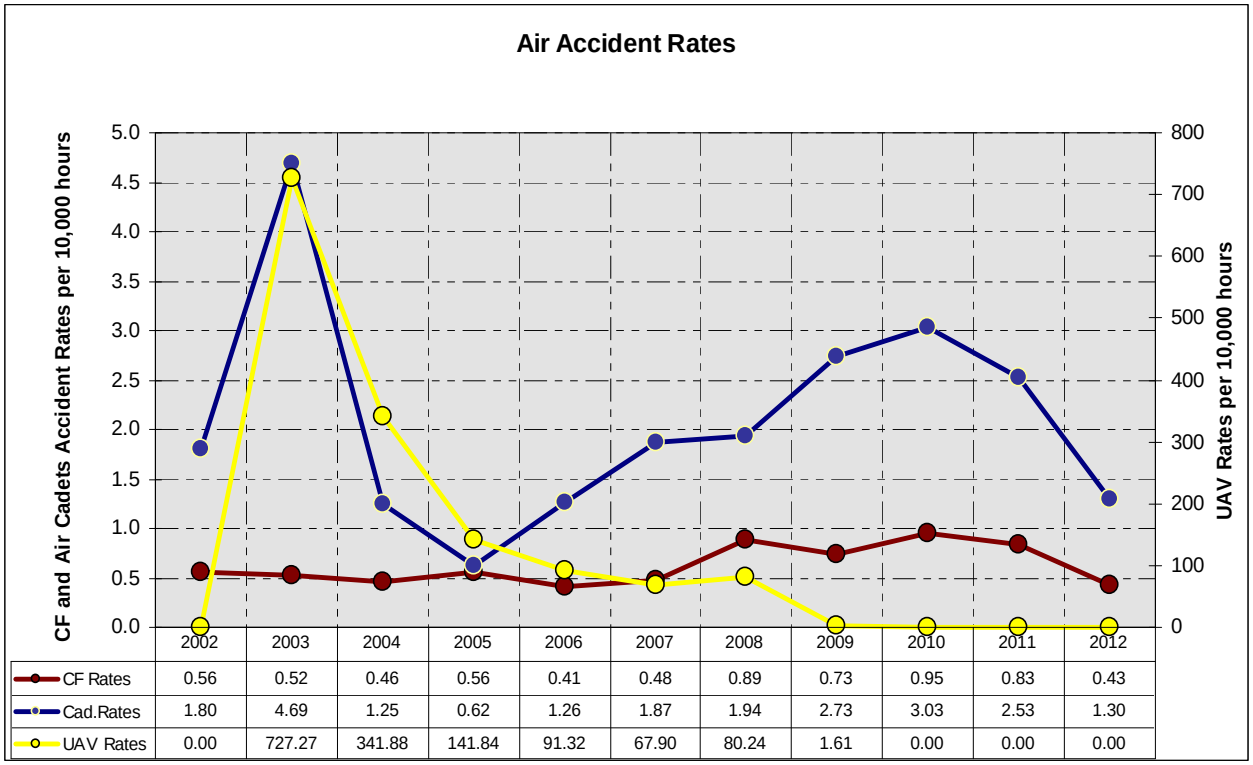
	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Damage/Injuries Rates	25.6	23.6	36.7	45.1	44.2	42.0	48.7	49.5	39.0	40.7	52.9
No Damage/No Injuries Rates	158.7	162.8	159.9	168.9	148.4	151.2	161.5	190.0	169.4	166.4	194.4
Total Number of Occurrences	2942	2827	2888	3016	2673	2733	2979	3437	3117	3148	3236

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 Air Cadets and UAV accidents, has decreased significantly from a three year high point compared to 2010 (0.43 vs. 0.95), and has fallen below the 10-year mean (0.64). The breakdown of air accidents was one category A (CC130 *Hercules*) one category 'B' accidents (CH146 *Griffon*) and two category 'C' accidents (one CH146 *Griffon* and one CC138 *Twin Otter*). The Air Cadets accident rate has decreased from last year's high (1.30 vs. 2.42). The 2012 accident rate is based on one category 'B 'accident (SZ23 glider) and one category 'C' accident (L-19 *Bird Dog*). Statistical data for the Air Cadet program shows a continuing decrease from the last year (1.30 vs. 2.53) falling to levels not seen since 2006, and is below the previous 5-year mean (2.42) at Table 5. The UAV accident rate remains at zero.



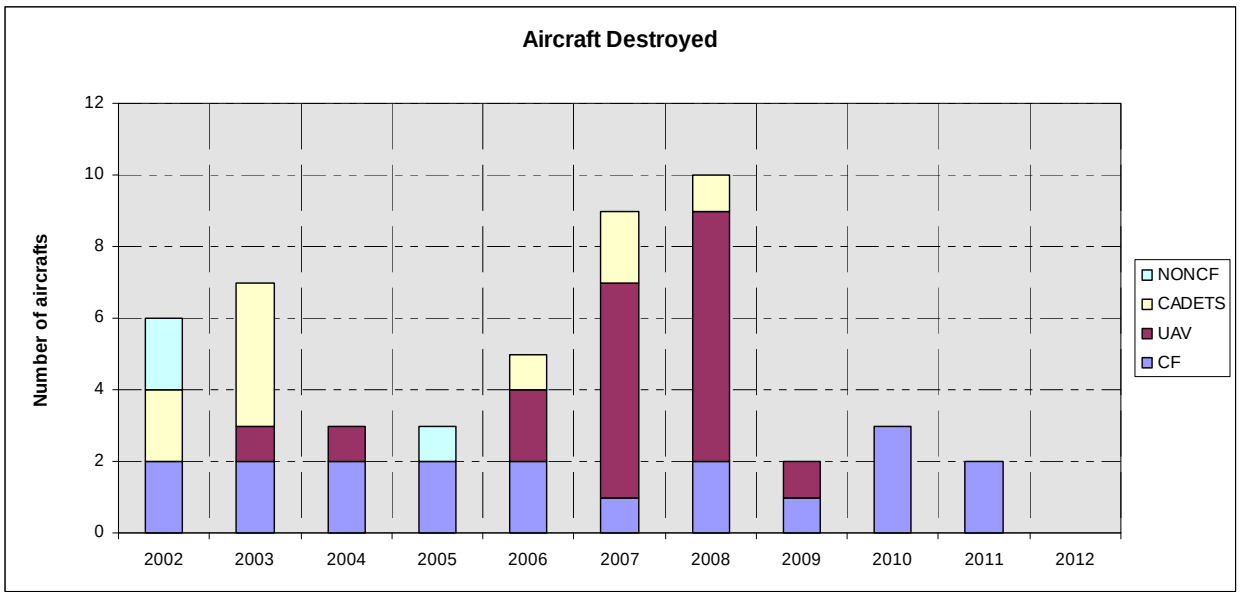
Graph 3 – Air Accident Rates
Note: 2003 Cadet outlier value discounted for the purposes of 10 year mean

Air Accident Rates	11	07-11 Mean	07-11 SD	12	D
CF Rates (Excluding Cadets and UAVs)	0.83	0.78	0.18	0.43	-1.88
Cadets Rates	2.53	2.42	0.50	1.30	-2.23
UAV Rates	0.00	29.95	40.52	0.00	-0.74

Table 5 – Air Accident Rates

3.2.3.2 Aircraft Destroyed/Written-Off

There were no aircraft destroyed, but one glider was written off as a result of the extensive damage suffered during a ground occurrence. Graph 4 provides an overall view for the last 10 years, while Table 6 sub-divides the numbers between Air Cadets, CF, UAVs and Non-CF. The CF rate is in line with the 10-year mean.



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

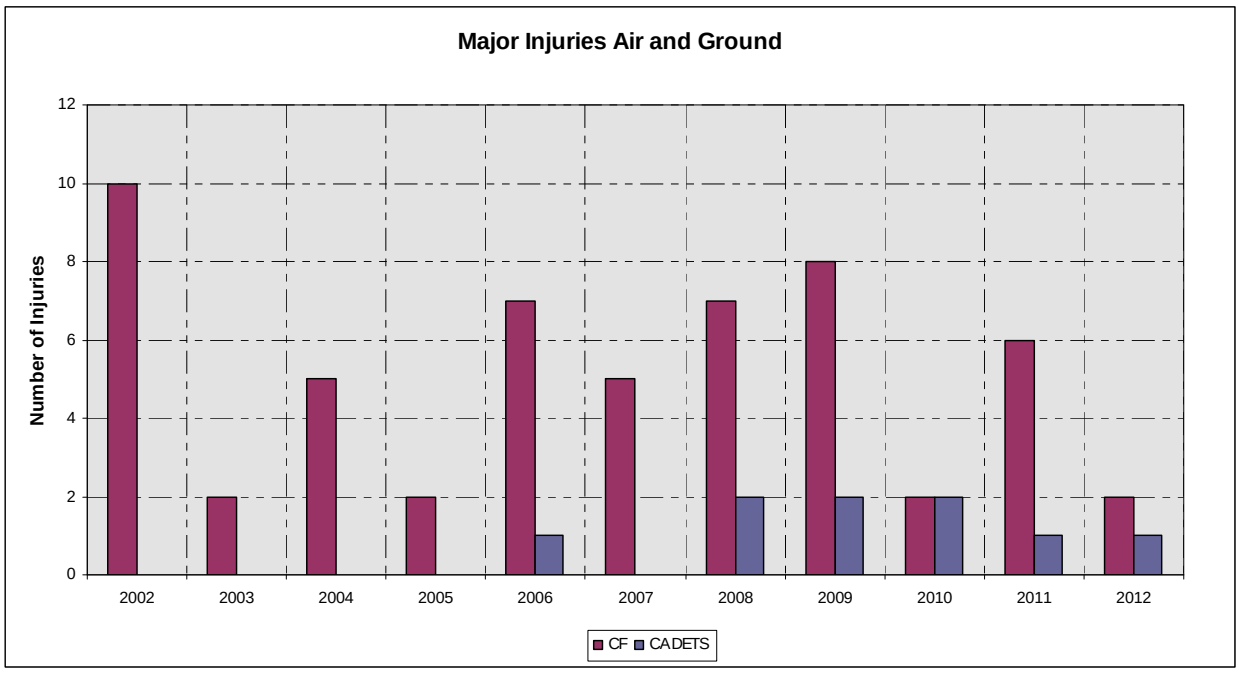
AIRCRAFT	02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
CF	2	2	2	2	2	1	2	1	3	2	1.9	0.6	0	-3.3
UAV	0	1	1	0	2	6	7	1	0	0	1.8	2.6	0	-0.7
CADETS	2	4	0	0	1	2	1	0	0	0	1.0	1.3	0	-0.8
NONCF	2	0	0	1	0	0	0	0	0	0	0.3	0.7	0	-0.4
Total	**6**	**7**	**3**	**3**	**5**	**9**	**10**	**2**	**3**	**2**	**5.0**	**2.9**	2	**-1.7**

Table 6 – Aircraft Destroyed
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 were no fatalities in 2012. There was one serious Air Cadet injury due to a hard landing and two CF serious injuries (two maintenance technicians, one loosing footing in the aircraft, the other dealing with a runaway mule and power cart). The amount of serious injuries has returned to a level below our 10-year mean. The major injuries rate is lower than the 10-year average rate of 5.4.



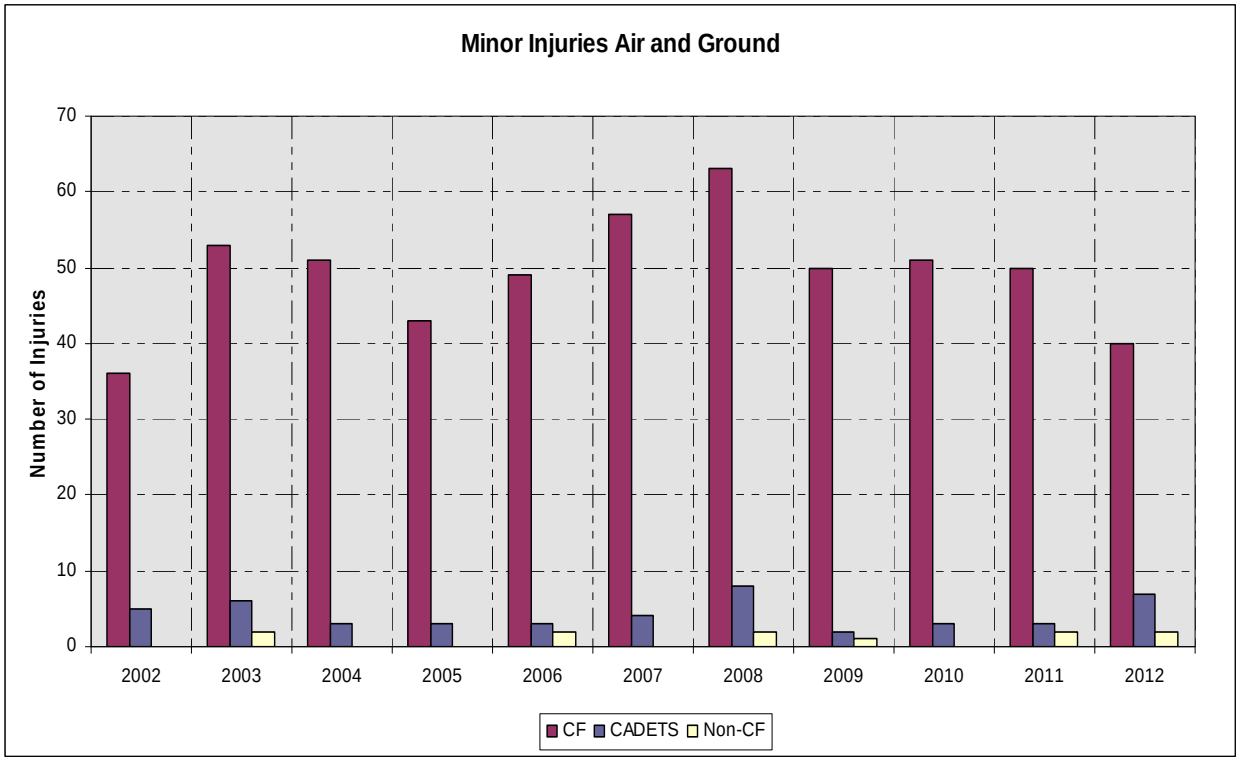
Graph 5 – Major Injuries Air and Ground

Year		02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
CF	Fatal	2	1	1	0	3	1	2	3	0	1	1.4	1.1	0	-1.3
	Very Serious	1	0	0	0	0	1	2	0	0	0	0.4	0.7	0	-0.6
	Serious	7	1	4	2	4	3	3	5	2	5	3.6	1.8	2	-0.9
	Total	**10**	**2**	**5**	**2**	**7**	**5**	**7**	**8**	**2**	**6**	**5.4**	**2.8**	**2**	**-1.2**
CADETS	Very Serious	0	0	0	0	0	0	1	0	0	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	1	0	1	2	2	1	0.7	0.8	1	0.4
	Total	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**2**	**2**	**1**	**0.8**	**0.9**	**1**	0.2

Table 7 – Major Injuries Air and Ground

3.2.4.2 Minor Injuries

Graph 6 shows a total of 49 minor injuries occurred in 2012, a decrease of 6 from the previous year. Although the CF decreased by 20%, the Air Cadets suffered a peak year reducing the overall decrease to 10%. Table 8 shows a potential area of concern for Air Cadet minor injuries.



Graph 6 – Minor Injuries Air and Ground

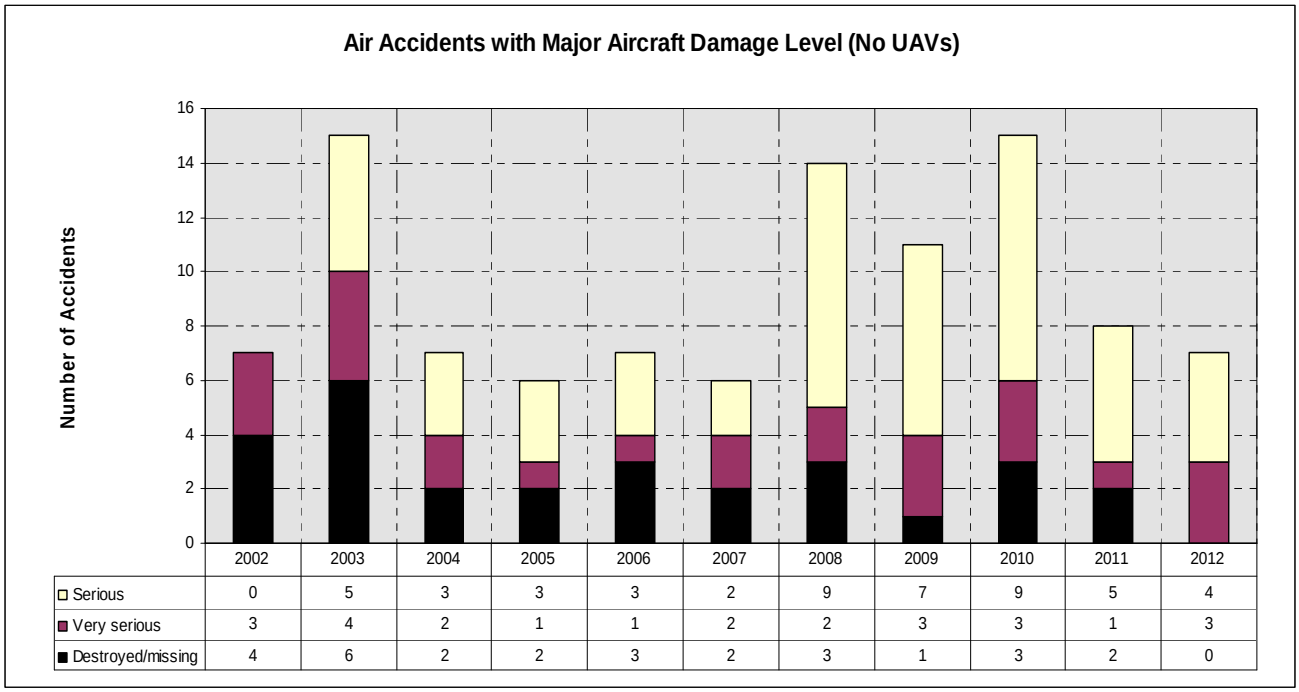
Year	02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
Cadets	5	6	3	3	3	4	8	2	3	3	4.0	1.8	7	1.6
CF	36	53	51	43	49	57	63	50	51	50	50.3	7.3	40	-1.4
Non-CF	0	2	0	0	2	0	2	1	0	0	0.9	1.0	2	1.1
Total	**41**	**61**	**54**	**46**	**54**	**61**	**73**	**53**	**54**	**55**	**55.2**	**8.7**	**49**	**-0.7**

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 seven with no aircraft destroyed. This is near the mean and is seen as a continued positive change to the 2008-2010 period. (Graph 7).



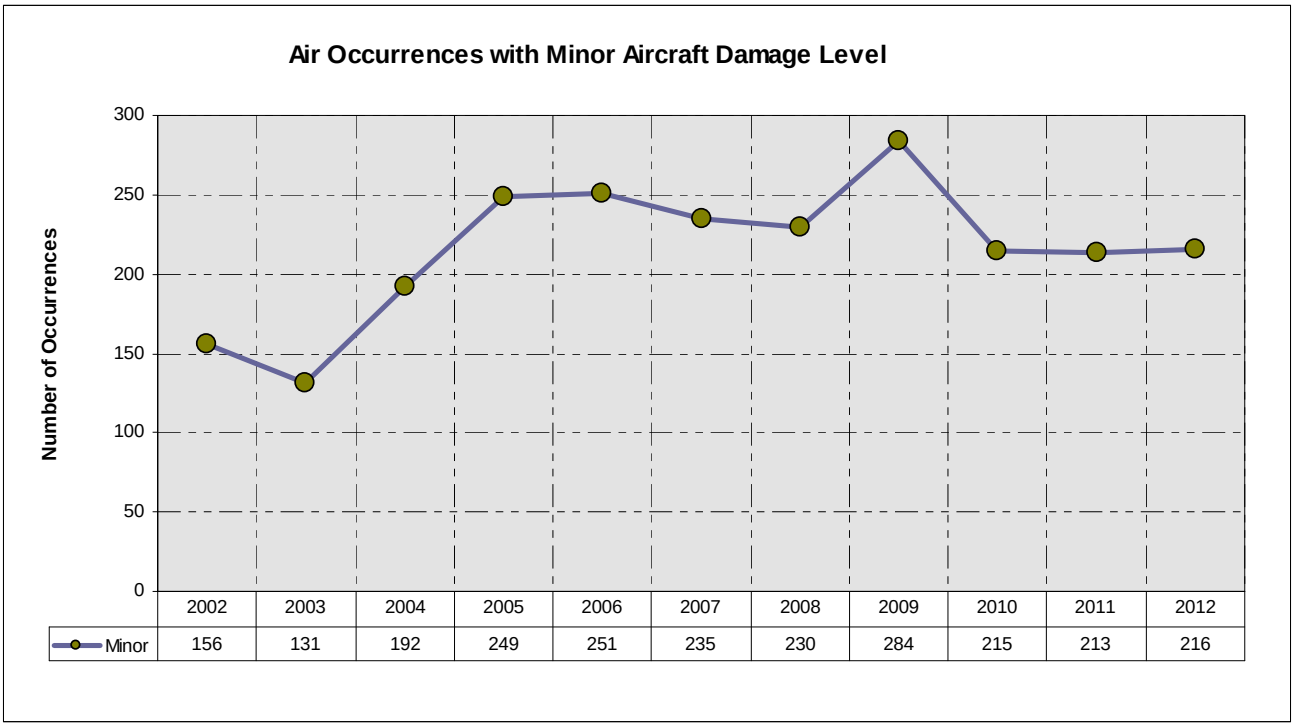
Graph 7 – Air Accidents by Major Aircraft Damage Level (No UAVs)

MAJOR ADL BY A/C TYPE		02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
CADETS	Destroyed	2	4	0	0	1	1	1	0	0	0	0.9	1.3	0	-0.7
	Very Serious	1	1	1	1	1	1	2	2	3	1	1.4	0.7	1	-0.6
	Serious	0	3	1	0	0	1	0	2	1	2	1.0	1.1	**1**	0.0
	Total	**3**	**8**	**2**	**1**	**2**	**3**	**3**	**4**	**4**	**3**	**3.3**	**1.9**	**2**	**-0.7**
CF	Destroyed	2	2	2	2	2	1	2	1	3	2	1.9	0.6	0	-3.3
	Very Serious	2	3	1	0	0	1	0	1	0	0	0.8	1.0	2	1.2
	Serious	0	2	2	3	3	1	9	5	8	3	3.6	2.9	3	-0.2
	Total	**4**	**7**	**5**	**5**	**5**	**3**	**11**	**7**	**11**	**5**	**6.3**	**2.8**	**5**	**-0.5**
UAV	Destroyed	0	1	1	0	2	6	7	1	0	0	1.8	2.6	0	-0.7
	Very Serious	0	1	2	0	5	0	9	0	0	0	1.7	3.0	0	-0.6
	Serious	0	2	1	2	1	1	0	0	0	0	0.7	0.8	0	-0.9
	Total	**0**	**4**	**4**	**2**	**8**	**7**	**16**	**1**	**0**	**0**	**4.2**	**5.1**	**0**	**-0.8**
Total		**7**	**19**	**11**	**8**	**15**	**13**	**30**	**12**	**15**	**8**	**13.8**	**6.8**	**7**	**-1.0**

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

3.2.5.2 Air Occurrences with Minor ADL

In 2012, the number of occurrences with minor ADL was again almost identical to 2011 (216 vs. 213) although the Air Cadets doubled the values of the past two years (Graph 8).



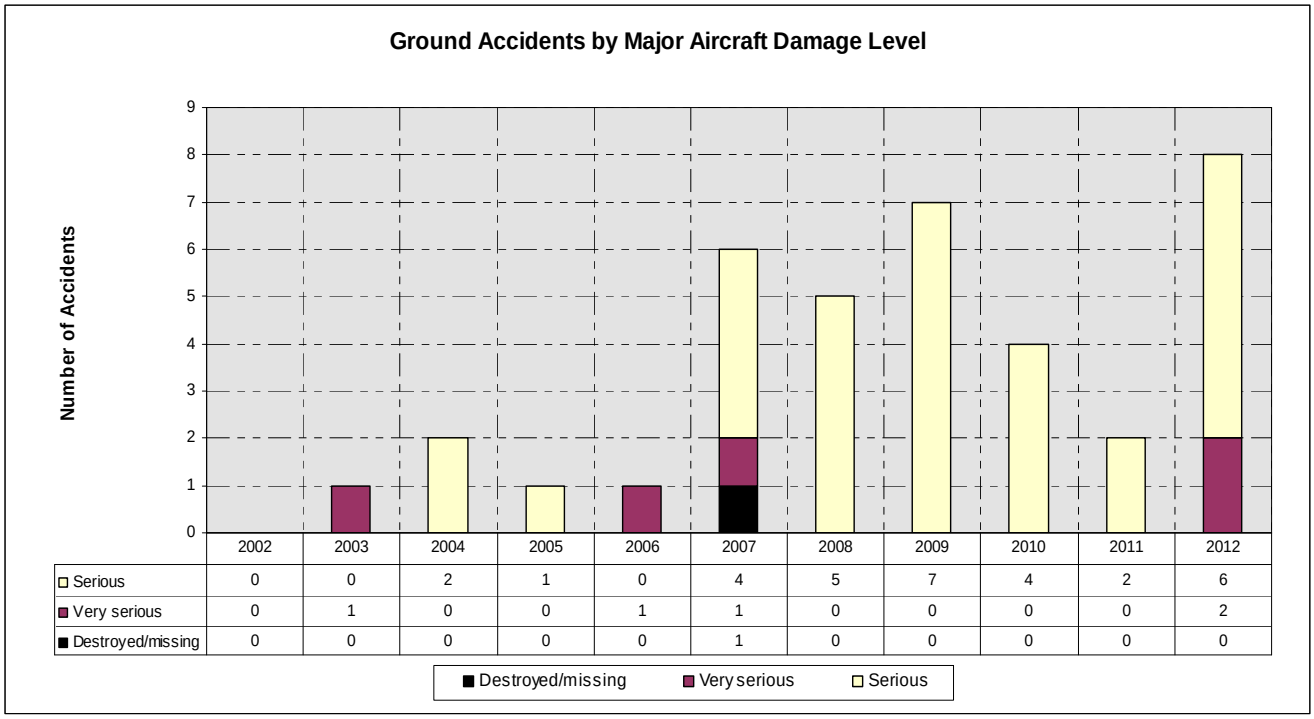
Graph 8 – Air Occurrences with Minor Aircraft Damage Level

AIR OCCURRENCES WITH MINOR ADL	02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
CADETS	20	11	8	10	19	11	19	17	9	10	13.4	4.7	21	1.6
CF	136	118	181	236	209	216	203	258	204	203	196.4	42.3	195	0.0
UAV	0	2	3	3	23	8	8	9	2	0	5.8	6.9	0	-0.8
Total	**156**	**131**	**192**	**249**	**251**	**235**	**230**	**284**	**215**	**213**	**215.6**	**45.8**	**216**	**0.0**

Table 10 – Air Occurrences with Minor ADL by Aircraft Types

3.2.5.3 Ground Accidents by ADL

Overall, the numbers of ground occurrences with major ADL spiked to levels slightly above the 10 year mean. (Graph 9 and Table 11). Three accidents were preventable.



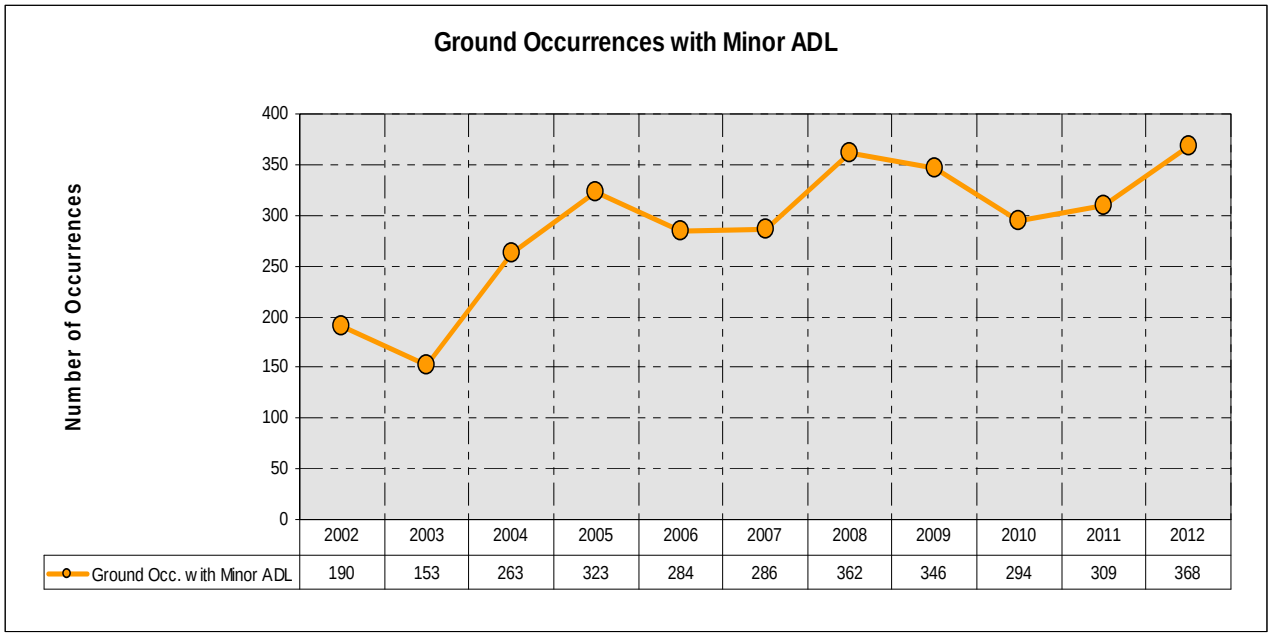
Graph 9 – Ground Accidents by Aircraft Damage Level

GROUND ACCIDENTS WITH MAJOR ADL BY A/C TYPE		02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
CADETS	Destroyed	0	0	0	0	0	1	0	0	0	0	0.1	0.3	0	-0.3
	Very Serious	0	0	0	0	1	0	0	0	0	0	0.1	0.3	2	6.0
	Serious	0	0	0	0	0	0	0	0	2	0	0.2	0.6	0	n/a
	Total	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**2**	**0**	**0.4**	**0.7**	**2**	**2.3**
CF	Very Serious	0	1	0	0	0	0	0	0	0	0	0.1	0.3	0	-0.3
	Serious	0	0	2	1	0	4	5	6	2	2	2.2	2.1	6	1.8
	Total	**0**	**1**	**2**	**1**	**0**	**4**	**5**	**6**	**2**	**2**	**2.3**	**2.1**	**6**	**1.8**
UAV	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	1	0	0	0.1	0.3	0	-0.3
	Total	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0.2**	**0.4**	**0**	**-0.5**
Total		**0**	**1**	**2**	**1**	**1**	**6**	**5**	**7**	**4**	**2**	**2.9**	**2.4**	**8**	**2.1**

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 to its highest point in the last decade (Graph 10 and Table 12). The number is above the 10-year mean, exceeds one standard deviation and is mainly attributable to CF operations.



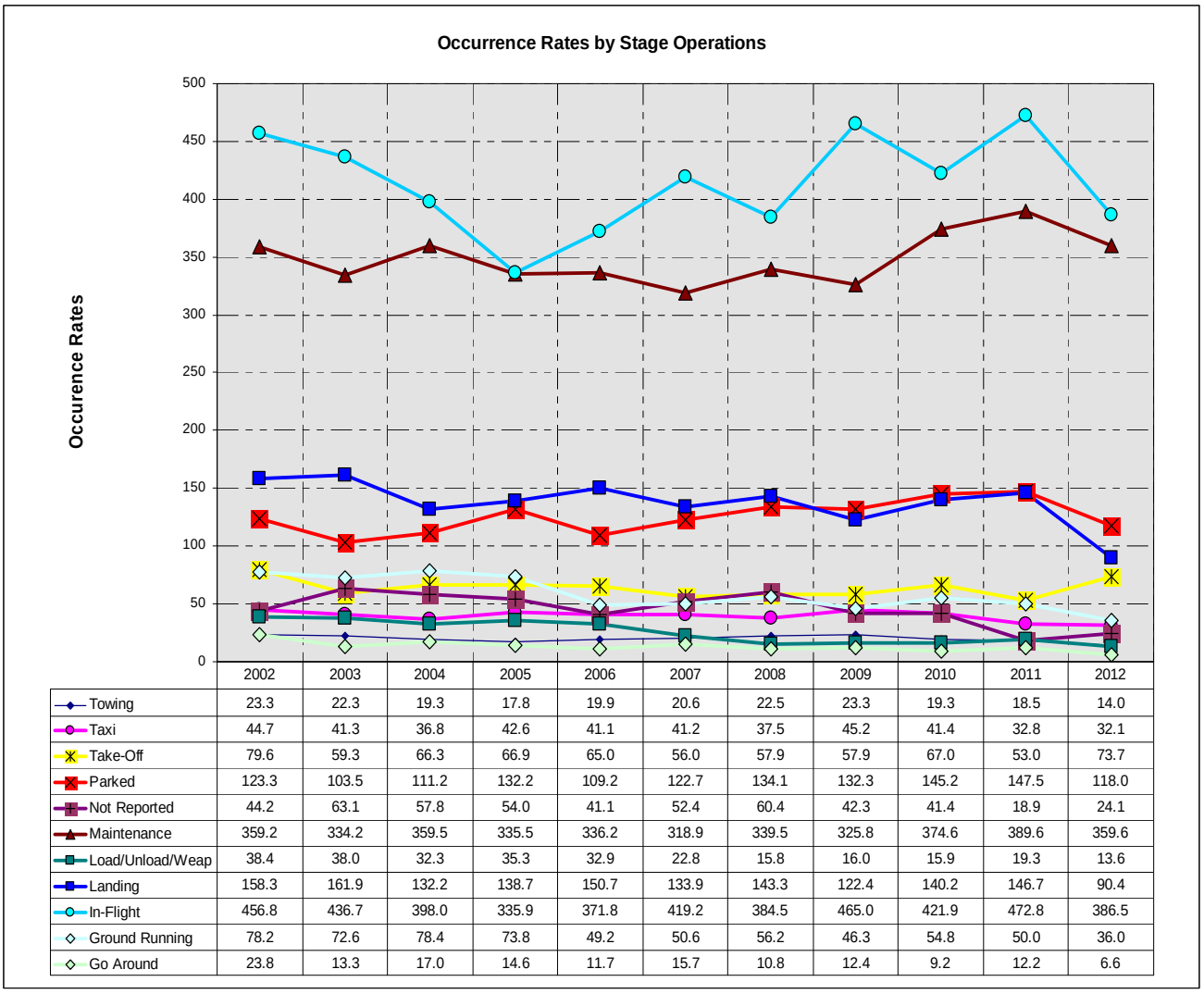
Graph 10 – Ground Occurrences with Minor Aircraft Damage Level

GROUND OCCURRENCE WITH MINOR ADL BY ORGANISATION	02	03	04	05	06	07	08	09	10	11	02-11 Mean	02-11 SD	12	D
CADETS	14	10	5	13	8	15	22	14	9	15	12.5	4.7	16	0.7
CF	176	141	257	309	276	269	340	331	285	294	267.8	63.8	352	1.3
UAV	0	2	1	1	0	2	0	1	0	0	0.7	0.8	0	-0.9
Total	**190**	**153**	**263**	**323**	**284**	**286**	**362**	**346**	**294**	**309**	**281**	**65.4**	**368**	**1.3**

Table 12 – Ground Occurrences with Minor ADL by organisation

3.2.5.5 Occurrences by Stage of Operations

There are two stages of operations that have shown a change in D values above the normal variation (Take-off and Not reported). These may be linked to the significant decrease in flight operations and deployed operations.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Towing	23.3	22.3	19.3	17.8	19.9	20.6	22.5	23.3	19.3	18.5	14.0
Taxi	44.7	41.3	36.8	42.6	41.1	41.2	37.5	45.2	41.4	32.8	32.1
Take-Off	79.6	59.3	66.3	66.9	65.0	56.0	57.9	57.9	67.0	53.0	73.7
Parked	123.3	103.5	111.2	132.2	109.2	122.7	134.1	132.3	145.2	147.5	118.0
Not Reported	44.2	63.1	57.8	54.0	41.1	52.4	60.4	42.3	41.4	18.9	24.1
Maintenance	359.2	334.2	359.5	335.5	336.2	318.9	339.5	325.8	374.6	389.6	359.6
Load/Unload/Weap	38.4	38.0	32.3	35.3	32.9	22.8	15.8	16.0	15.9	19.3	13.6
Landing	158.3	161.9	132.2	138.7	150.7	133.9	143.3	122.4	140.2	146.7	90.4
In-Flight	456.8	436.7	398.0	335.9	371.8	419.2	384.5	465.0	421.9	472.8	386.5
Ground Running	78.2	72.6	78.4	73.8	49.2	50.6	56.2	46.3	54.8	50.0	36.0
Go Around	23.8	13.3	17.0	14.6	11.7	15.7	10.8	12.4	9.2	12.2	6.6

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

OCCURRENCE RATES BY STAGE OF OPERATION	11	02-11 Mean	02-11 SD	12	D
Towing	18.5	20.7	2.0	14.0	-3.3
Taxi	32.8	40.4	3.8	32.1	-2.2
Take-Off	53.0	62.9	7.7	73.7	1.4
Parked	147.5	126.1	14.9	118.0	-0.5
Not Reported	18.9	47.6	13.0	24.1	-1.8
Maintenance	389.6	347.3	22.6	359.6	0.5
Load/Unload/W. Handling	19.3	26.7	9.6	13.6	-1.4
Landing	146.7	142.8	12.1	90.4	-4.3
In-Flight	472.8	416.3	44.0	386.5	-0.7
Ground Running	50.0	61.0	13.1	36.0	-1.9
Go Around	12.2	14.1	4.1	6.6	-1.8

Table 13 – Occurrence Rates by Stage of Operation

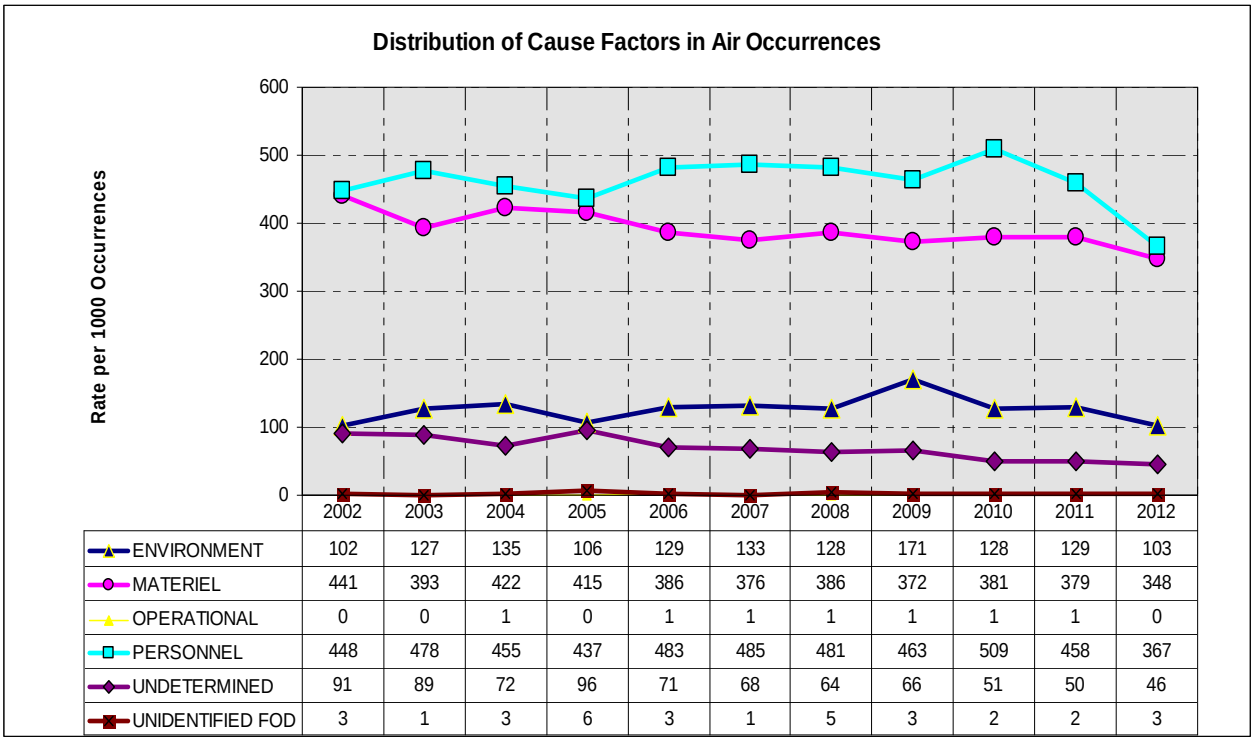
3.3 CAUSE FACTORS

3.3.1 Cause Factor Breakdown Analysis

Cause Factor analysis is based on data from completed reports only as draft reports are subject to change. To achieve consistency, 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 as they are incomplete and subject to change. Last year, the FS Program saw a large number of overdue occurrence reports (509 of 3149). This was initially thought to be related to when the annual report queries were conducted in Mar 12. This year, the queries were specifically delayed in order to provide the opportunity for units and wings to complete reports. As of 24 May, 18% of the 2012 occurrence reports were overdue (575 of the 3236). As well, there are 122 additional overdue occurrences related to years prior to 2102. Overdue occurrence reports have a detrimental effect on our ability to analyze and trend cause factors and the distribution of PM information. Preventive measures and their timely staffing and implementation by the chain of command are critical to an effective prevention program. This issue must be addressed under a separate venue. DFS continues to track overdue reports to validate the distribution hypothesis.

3.3.1.1 Air Occurrences

Graph 12 and Table 14 provide a breakdown of the attribution of air occurrence cause factors for 2012. Although the data appears to indicate a distinct decrease in all cause factors, analysis of the distribution is incomplete as a result of the 258 overdue air occurrence reports for 2012.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ENVIRONMENT	102	127	135	106	129	133	128	171	128	129	103
MATERIEL	441	393	422	415	386	376	386	372	381	379	348
OPERATIONAL	0	0	1	0	1	1	1	1	1	1	0
PERSONNEL	448	478	455	437	483	485	481	463	509	458	367
UNDETERMINED	91	89	72	96	71	68	64	66	51	50	46
UNIDENTIFIED FOD	3	1	3	6	3	1	5	3	2	2	3

Graph 12 – Distribution of Cause Factors in Air Occurrences

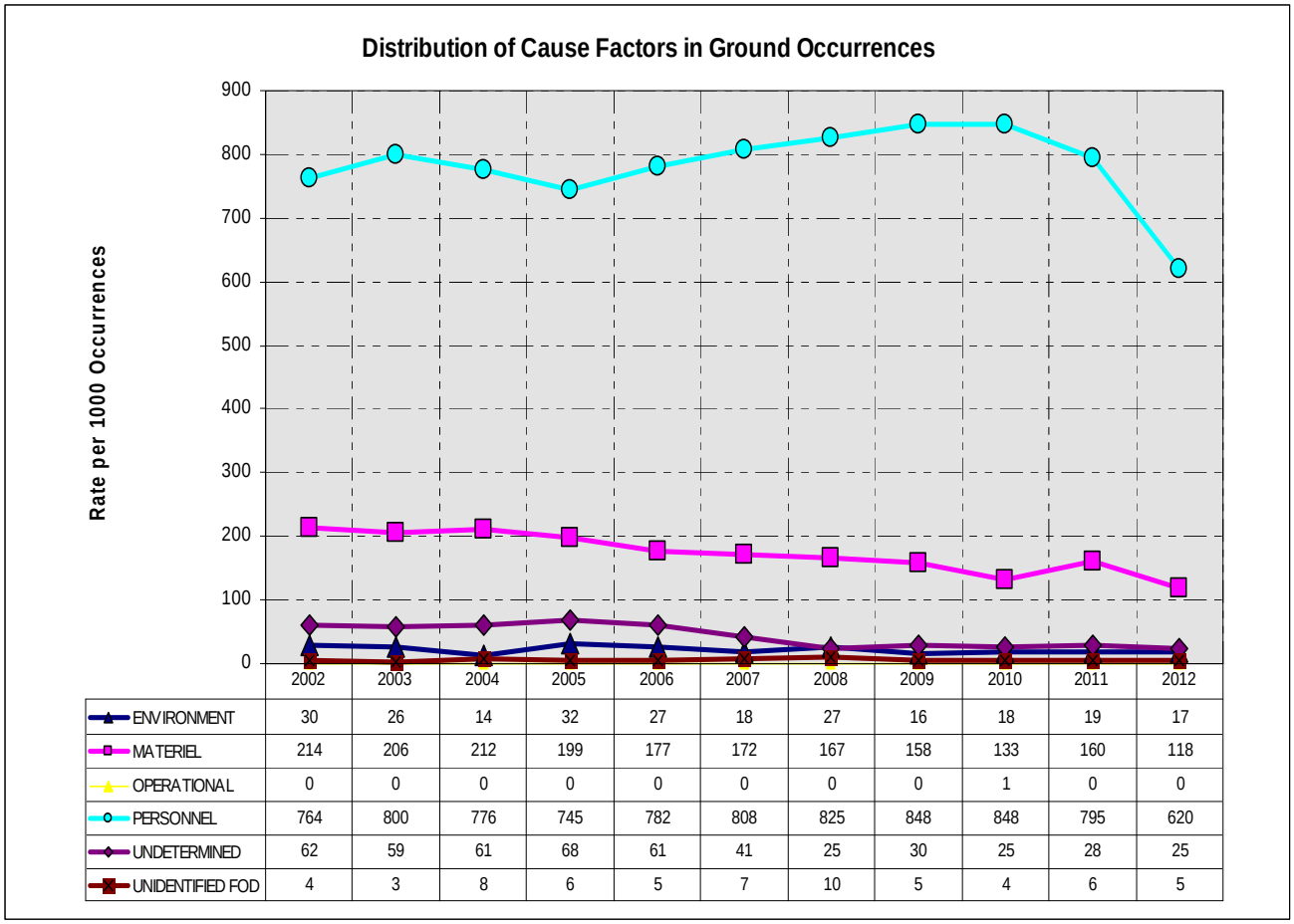
Note: The Nil (FTPO) factor is not considered in graph 12.

Air Cause Factors Rates by Type	2011	02-11 Mean	02-11 SD	2012	D
Environment	129	128.7	18.3	103	-1.4
Materiel	379	395.1	23.0	348	-2.0
Operational	1	0.6	0.5	0	-1.3
Personnel	458	469.8	21.4	367	-4.8
Undetermined	50	71.9	15.9	46	-1.6
Unidentified FOD	2	2.8	1.6	3	0.0

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 2012. Although the data indicates a distinct decrease in all cause factors rates, additional analysis of the distribution is incomplete as a result of 317 overdue ground occurrence reports.



	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ENVIRONMENT	30	26	14	32	27	18	27	16	18	19	17
MATERIEL	214	206	212	199	177	172	167	158	133	160	118
OPERATIONAL	0	0	0	0	0	0	0	0	1	0	0
PERSONNEL	764	800	776	745	782	808	825	848	848	795	620
UNDETERMINED	62	59	61	68	61	41	25	30	25	28	25
UNIDENTIFIED FOD	4	3	8	6	5	7	10	5	4	6	5

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	2011	02-11 Mean	02-11 SD	2012	D
Environment	19	22.7	6.6	17	-0.8
Materiel	160	179.8	26.9	118	-2.3
Operational	0	0.1	0.2	0	-0.3
Personnel	795	799.3	34.4	620	-5.2
Undetermined	28	46.0	17.7	25	-1.2
Unidentified FOD	6	6.0	2.2	5	-0.5

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.

CAUSE FACTORS		TYPE	CAUSE FACTORS vs. REPORTS FILED			
			Mean 04-11	2011	2012	RL 04-12
ACTIVE FAILURES						
ERRORS	**Decision Error**	**Air**	140.3	159.3	120.2	Very Low
		Ground	216.1	225.0	197.1	High
	Perception Error	**Air**	50.2	84.2	78.6	Very Low
		Ground	58.8	104.5	128.4	Very Low
	Skilled Based Error	**Air**	346.9	349.8	290.3	Very Low
		Ground	555.2	571.8	506.25	Medium
DEVIATIONS	**Routine Deviation**	**Air**	5.7	1.1	3.4	n/a
		Ground	21.9	17.4	8.9	High
	Exceptional Deviation	**Air**	16.3	11.9	14.0	High
		Ground	63.2	26.1	26.2	Very Low
LATENT CONDITIONS						
CONDITIONS OF PERSONNEL	**Mental State**	**Air**	274.4	297.7	302.6	Very-Low
		Ground	423.1	520.3	477.3	Very Low
	Physical / Mental Capabilities	**Air**	46.4	37.9	34.3	Very Low
		Ground	59.8	52.2	39.1	Medium

CAUSE FACTORS		TYPE	CAUSE FACTORS vs. REPORTS FILED			
			Mean 04-11	2011	2012	RL 04-12
	Physiological States	Air	4.5	4.0	1.1	n/a
		Ground	3.0	0.0	2.1	n/a
WORKING CONDITIONS	Technological Environment	Air	21.5	27.7	16.8	Medium
		Ground	34.2	26.1	30.9	Low
	Physical Environment	Air	32.8	48.0	28.1	Very Low
		Ground	50.5	55.9	35.7	Very Low
PRACTICES OF PERSONNEL	Resource Management	Air	69.4	73.4	74.1	Very Low
		Ground	94.4	106.7	101.0	Very Low
	Personal Readiness	Air	1.4	1.1	0.0	n/a
		Ground	1.5	1.5	0.7	n/a
SUPERVISION	Planned Activities	Air	14.5	14.7	7.3	Medium
		Ground	35.4	30.5	26.8	Very Low
	Problem Correction	Air	8.2	6.2	8.4	High
		Ground	23.2	20.3	17.2	High
	Supervisory Deviation	Air	2.0	3.4	3.4	n/a
		Ground	9.7	8.7	6.9	High
	Level of Supervision	Air	50.5	47.5	48.3	Very Low
		Ground	148.5	175.6	144.9	High
ORG INFLUENCES	Organizational Climate	Air	10.7	16.9	7.9	Low
		Ground	27.2	31.9	24.0	Very Low
	Organizational Process	Air	24.0	22.6	15.2	High
		Ground	61.6	53.7	39.1	High
	Resource Management	Air	12.2	9.6	10.7	High
		Ground	35.0	33.4	21.3	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 randomness level (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 02-11	11	12	RL 02-12
ALL A/C	**N/A**	**167.9**	**143.4**	**179.2**	**Low**
CC115 Buffalo	**Overall**	**326.2**	**284.2**	**346.4**	**Low**
	Weapons systems	55.8	52.2	90.9	Very low
	Undercarriage (landing gear)	33.0	34.8	39.8	Medium
	Jet/Turbo basic Engine	15.2	0.0	34.1	n/a
CC130 Hercules	**Overall**	**244.8**	**268.7**	**386.1**	**Low**
	Weapons Systems	25.4	65.6	63.5	Very low
	Propeller/Engine Controls /Instruments	23.6	37.8	39.5	Low
	Propeller	18.4	20.2	37.7	Low
CC130 J Hercules	**Overall**	**98.7**	**131.1**	**143.7**	**n/a**
	Flaps	9.5	11.7	19.5	n/a
	Panels/Doors/Transparent areas	29.5	25.7	17.7	n/a
	Propeller/Engine Controls /Instruments	1.8	7.0	17.7	n/a
CC138 Twin Otter	**Overall**	**99.2**	**162.0**	**153.5**	**Medium**
	Undercarriage (landing gear)	10.8	0.0	33.4	n/a
	Fuel Systems	10.4	14.1	26.7	n/a
	Fuselage/Wings/Empennage	11.3	49.3	26.7	n/a
CC144 Challenger	**Overall**	**25.8**	**33.0**	**51.2**	**High**
	Fuel Systems	1.4	3.7	11.0	n/a
	Flaps	2.2	0.0	7.3	n/a
	Panels/Doors/Transparent areas	4.6	0.0	7.3	n/a
CC150 Polaris (Airbus 310)	**Overall**	**33.8**	**26.2**	**37.5**	**Very Low**
	Panels/Doors/Transparent areas	5.6	0.0	11.3	n/a
	Electrical Systems	0.8	4.0	7.5	n/a
	Undercarriage (Landing Gear)	2.1	2.0	7.5	n/a
CC177	**Overall**	**37.5**	**29.1**	**50.3**	**n/a**

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 02-11	11	12	RL 02-12
Globemaster III	Undercarriage (Landing Gear)	2.3	1.7	10.6	n/a
	Furnishings And Loose Equipment	3.1	6.8	7.9	n/a
	Pneumatics (Inc Heat & Vent)	1.7	0.0	7.9	n/a
CF188 Hornet	**Overall**	**348.5**	**313.1**	**422.2**	**Medium**
	Weapons Systems	66.2	75.2	105.2	High
	Undercarriage (Landing Gear)	43.6	38.3	53.7	High
	Jet / Turbo Basic Engine	30.1	22.2	43.0	Medium
CH124 Sea King	**Overall**	**179.4**	**128.5**	**178.4**	**High**
	Weapons Systems	12.8	7.0	21.6	High
	Hydraulics	9.5	10.5	16.2	High
	Jet / Turbo Basic Engine	9.1	3.5	14.9	High
CH139 Jet Ranger Bell 206B	**Overall**	**62.0**	**62.5**	**69.1**	**Very Low**
	Helicopter Flight Controls	18.5	13.4	14.8	n/a
	Lubrication Systems	3.2	0.0	14.8	n/a
	Fuel Systems	3.7	4.5	9.9	n/a
CH146 Griffon	**Overall**	**140.2**	**160.0**	**202.6**	**Very Low**
	Helicopter Flight Controls	23.6	27.6	25.2	Medium
	Panels / Doors / Transparent Areas	11.5	13.0	22.4	High
	Helo Main Rotor Head / Rotor Drive Train	12.4	20.0	17.5	High
CH149 Cormorant	**Overall**	**226.9**	**215.4**	**211.1**	**Medium**
	Furnishings and Loose Equipment	43.5	67.5	31.9	High
	Survival & Safety Equipment	16.1	11.3	21.3	High
	Panels / Doors / Transparent Areas	14.8	24.4	17.7	Very Low
CP140 Aurora	**Overall**	**236.8**	**182.1**	**234.6**	**High**
	Weapon Systems	19.3	23.6	31.2	High
	Electrical Systems	26.7	15.7	23.8	Medium
	Undercarriage (Landing Gear)	18.0	14.1	23.8	Medium
CT102 Astra	**Overall**	**65.0**	**41.0**	**51.5**	**High**
	Undercarriage (Landing Gear)	14.2	9.9	12.1	High
	Flaps	3,2	2.5	7.6	n/a
	Electrical Systems	4.6	3.7	4.5	n/a
CT114 Tutor	**Overall**	**148.1**	**140.3**	**152.5**	**High**
	Survival & Safety Equipment	18.8	25.5	25.4	High
	Fuselage / Wings / Empennage	23.0	17.9	22.6	Low
	Undercarriage (Landing Gear)	21.1	28.1	19.8	Medium

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 02-11	11	12	RL 02-12
CT142 Dash-8	**Overall**	**99.9**	**126.2**	**188.4**	**Low**
	Survival & Safety Equipment	6.8	14.0	42.6	n/a
	Undercarriage (Landing Gear)	13.7	18.7	42.6	n/a
	Electrical Systems	4.8	0.0	18.2	n/a
CT145 King Air	**Overall**	**40.0**	**46.5**	**40.8**	**High**
	Fuselage / Wings / Empennage	3.6	12.9	8.7	n/a
	Undercarriage (Landing Gear)	10.0	7.8	8.7	High
	Electrical Systems	1.3	0.0	2.9	n/a
CT155 Hawk	**Overall**	**146.9**	**130.0**	**89.2**	**High**
	Undercarriage (Landing Gear)	33.2	22.0	26.4	Very Low
	Survival & Safety Equipment	12.1	16.5	14.9	High
	Jet / Turbo Basic Engine	6.7	1.8	8.3	High
CT156 Harvard II	**Overall**	**96.8**	**51.3**	**55.9**	**Very Low**
	Undercarriage (Landing Gear)	33.1	15.6	18.6	Low
	Survival & Safety Equipment	11.3	9.2	10.2	High
	Flaps	8.8	6.3	6.0	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

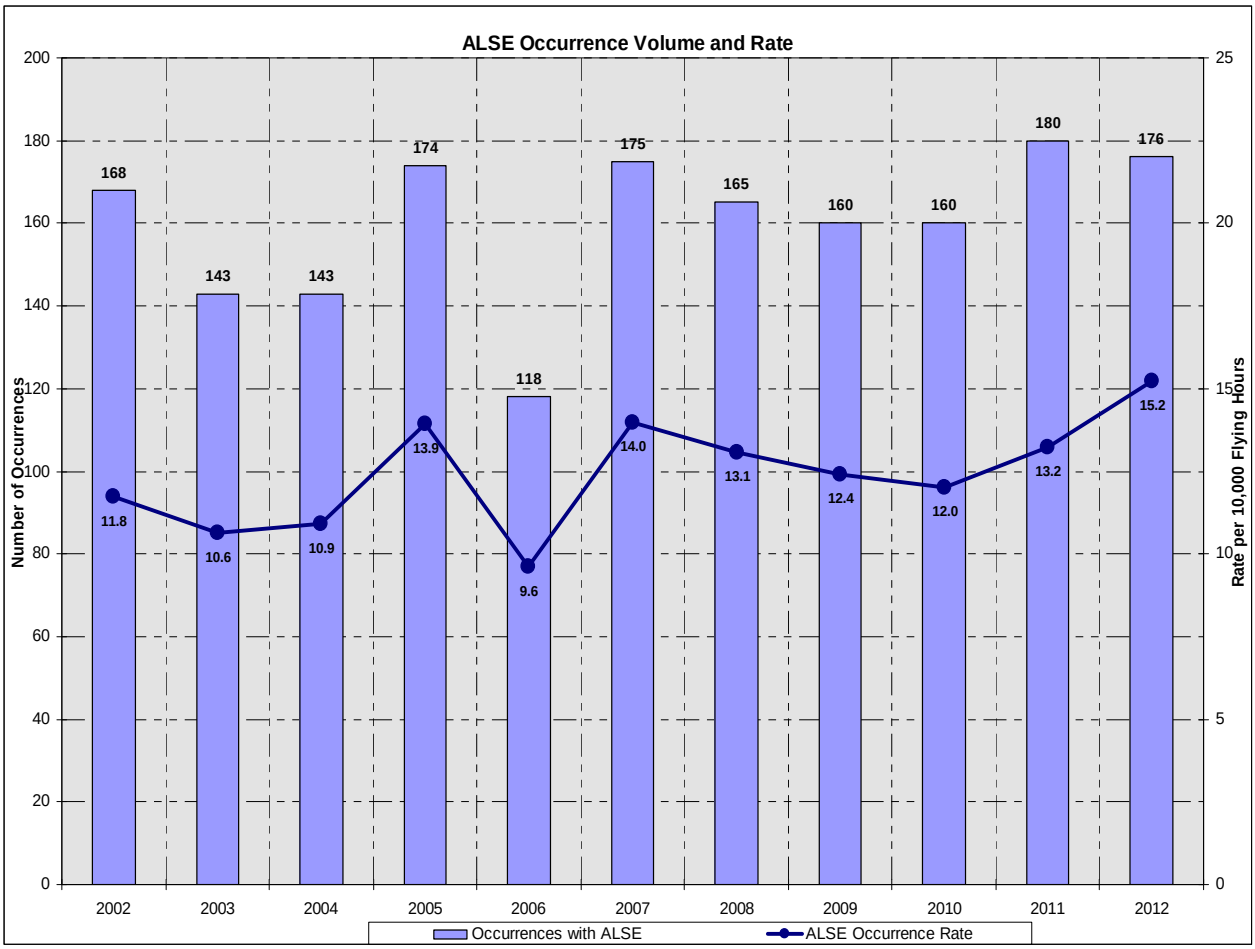
- CC115. There are no FS concerns at this time.
- CC130. There are no FS concerns at this time. The Propeller systems descriptor is associated to issues of Propeller Low Oil Light indications that continue to be a concern with the legacy CC130 fleet.
- CC130J. There are no FS concerns at this time.
- CC138. There are no FS concerns at this time.
- CC144. There are no FS concerns at this time.
- 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. Of the 694 occurrences filed for 2012, 114 remain open. 47 of these contain brief personnel as a PMs that have yet to be carried out. 16 E cat are more than 12 months overdue.
- CH124. A key areas of concern is the lack of experience among both air and ground crew.
- CH139. Traffic conflicts between Jet Ranger, Grob and Outlaw are present due to circuit

pattern routing resulting in some over-flight events leading to rotor wash issues.

- CH146. Key areas of concern are low experience and lack of supervision. This is indicative of a trend. Although the Panels / Doors / Transparent Areas system descriptor was highlighted, analysis of the related occurrences didn't warrant concern as they were spread over several sub-systems.
- CH149. Although there are no FS concerns at this time, a hazard was raised in 2009 against the communications system since it often fails causing an extremely high pitch squeal throughout all stations on the aircraft. DFS is concerned with the lack of progress with this Hazard.
- CP140. There are no FS concerns at this time. Although the weapons system descriptor was highlighted, analysis of the related occurrences identified materiel ammunition defects as the main cause.
- CT102. Although there are no FS concerns at this time, this fleet experiences a rather low number of ground occurrences and documentation of occurrences in FSOMS doesn't include sufficiently developed relevant PMs.
- CT114. Although there are no FS concerns identified at this time, 20 of 69 occurrences raise staffing issues where PMs aren't completed or updated. FOD program should be revised due to a high number of occurrences and there is a repeated use of brief personnel PM.
- CT142. Although there are no FS concerns at this time, there was a noted increase in the landing gear occurrences linked to rigging tolerances. The accepted PM was to conduct training scheduled 18 months after the original occurrence. Defence Resource Information Management System (DRIMS) was again identified as a documentation issue in six of 37 occurrences for 2012.
- CT145. There are no FS concerns at this time.
- CT155. There are no FS concerns at this time. There were 12 near mid-air occurrences, traffic conflicts, and runway incursions during the reporting period.
- CT156. Near mid-air collision and traffic conflicts remain a concern. Although there is a preventive measure from ESR 139592 (13 Aug 09) to implement a means of alerting pilots of a traffic conflict, little has been done to address this significant issue.
- CT146. There are no FS concerns at this time.
- SZ23. Although there are no FS concerns at this time, 55 of the 2012 occurrences remain open with incomplete PMs or FSOMS documentation.
- Air Cadet Glider Program Tow Planes. There are no open PMs from tow aircraft.

3.3.4 Aircrew Life Support Equipment (ALSE).

The number of occurrences related to survival and safety equipment has decreased slightly in the last year from 180 to 176. The rate has continued to increase to 15.2 and has exceeded two SD, we are at the highest level in the past 11 years. (Graph 14).



Graph 14 – ALSE Occurrence Volume and Rate

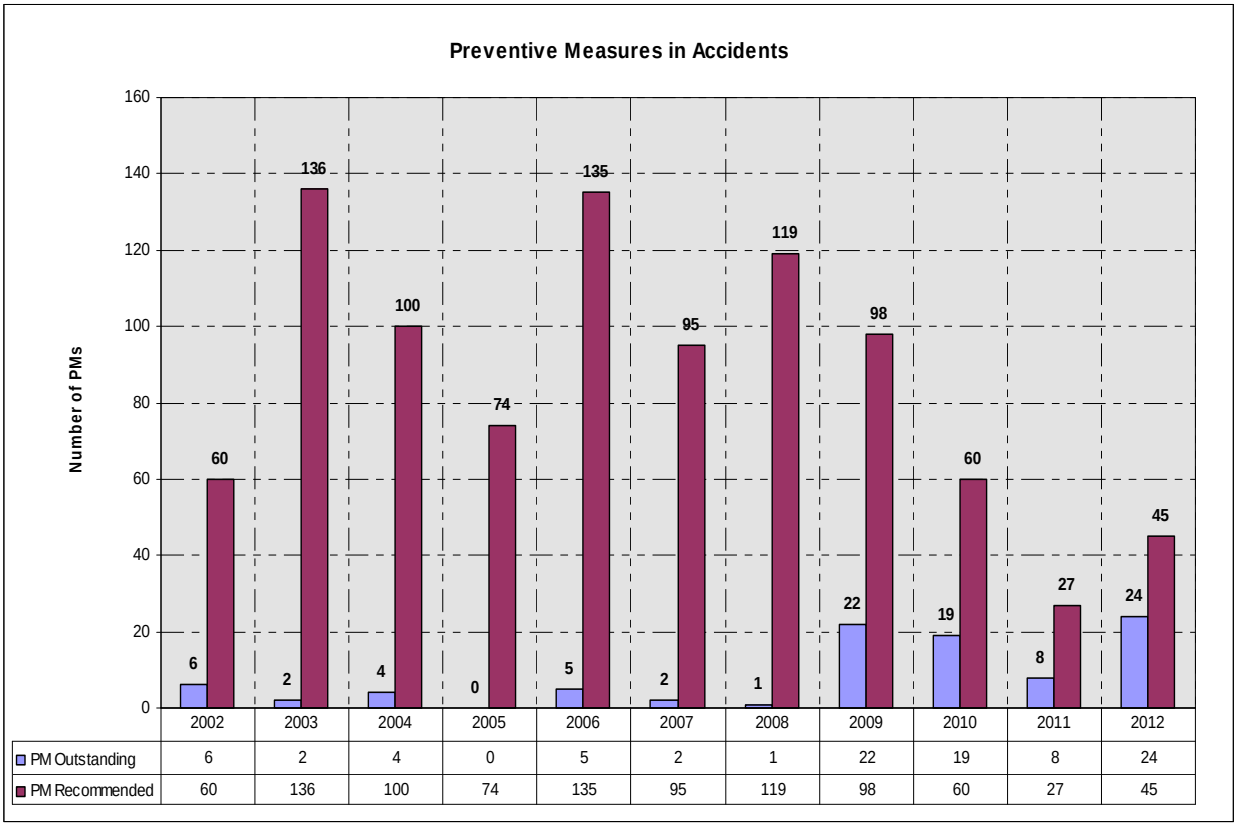
	11	02-11 Mean	02-11 SD	12	D
ALSE RATES	13.2	12.2	1.5	15.2	2.1

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 18 PMs recommended remain outstanding from 2008 or earlier. This value is 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.

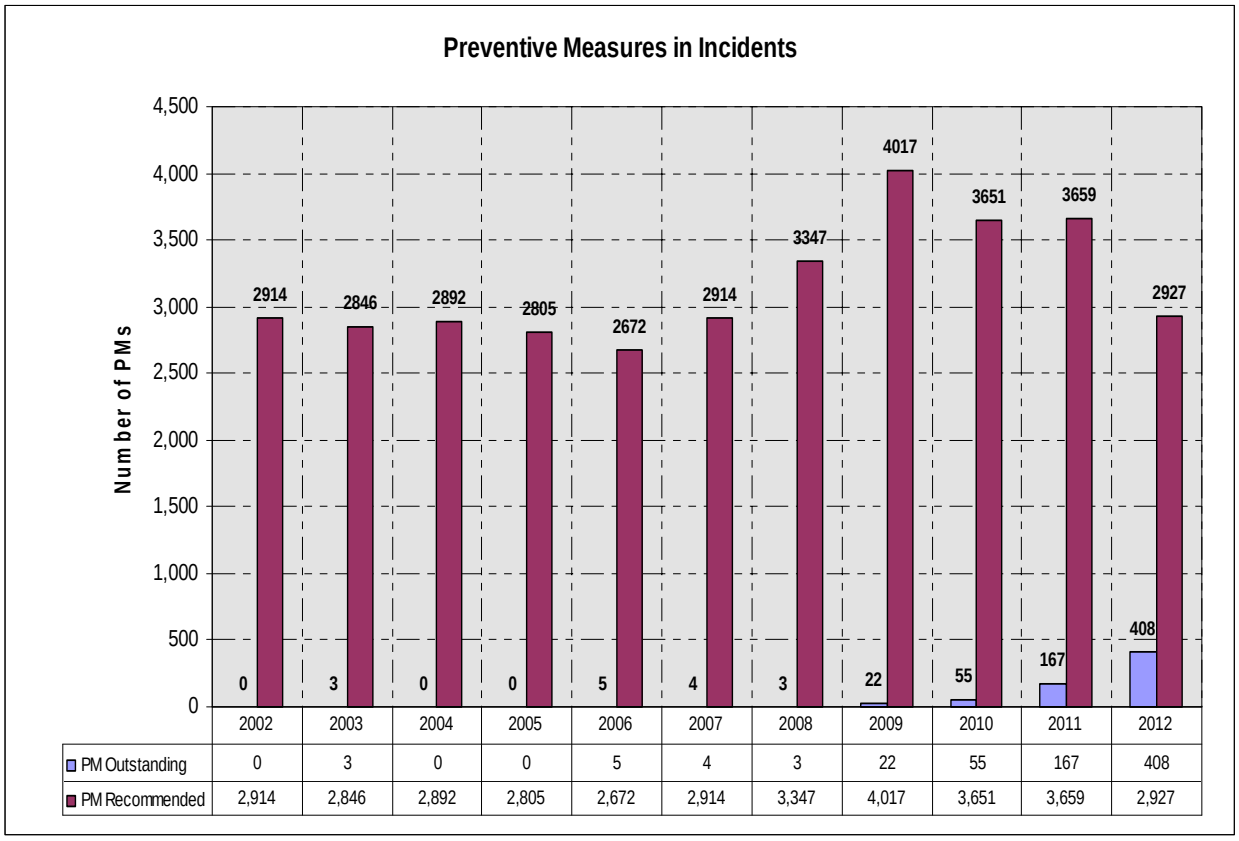


	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
PM Outstanding	6	2	4	0	5	2	1	22	19	8	24
PM Recommended	60	136	100	74	135	95	119	98	60	27	45

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. 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 37 PMs remain outstanding from 2009 and earlier. This value is slightly lower compared to last years report.



Graph 16 – Outstanding and Recommended Preventive Measures from Incidents

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4. STATISTICAL METHODOLOGIES

4.1 COEFFICIENT OF DEVIATION VALUE (D)

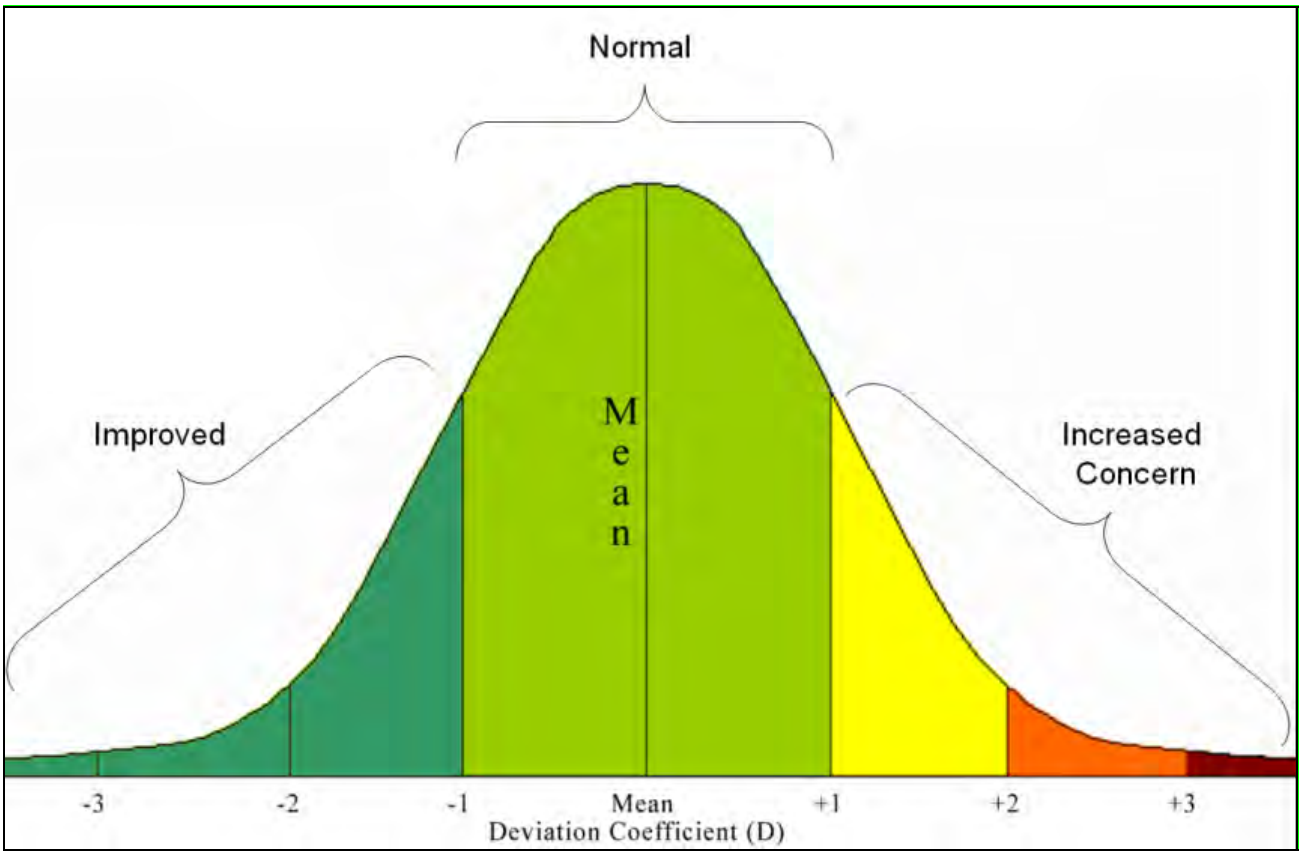
Data values are typically distributed on either side of the mean value. The DFS Statistician measured how far the values are from mean in order to provide an indication of how standard (within a usual range), or alternatively how abnormal (outside of usual range) the value may be, expressed as D. D is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