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2010
Annual Report on Flight Safety

Canada

DIRECTOR COMMENTS

This is the 6th Annual Report on Flight Safety for DND/CF. The report provides a synopsis of the investigations carried out by the Airworthiness Investigation Authority and the activities of the Directorate of Flight Safety for 2010. The report is divided in three parts: it provides an update on Airworthiness Program related activities, describes the Flight Safety Program activities for the year, and presents an analysis of the 2010 Flight Safety data by comparing it with data from previous years. The report continues to refine the statistical methodologies introduced in 2009 in order to provide a better perspective on the data presented.

Flight Safety witnessed some challenges this year through the continued introduction of new aircraft combined with a high operational tempo. Personnel shortages, especially at the supervisory levels, and the "pipeline" air force have necessitated a high level of vigilance by all. The Flight Safety Program is feeling the impact of increased workload due to investigations in theatres of operations and the extra effort required to provide oversight of the numerous organizations contracted to support Canadian Forces flying operations. The significant number of Class I investigations and a larger number of facilities to survey combined with staff shortages has challenged our personnel. That said, the number (3,138) and the rate (210.69) of reported occurrences have both decreased since last year and we need to focus our activities to ensure we are capturing the lessons that will help us prevent accidental loss of personnel and limited valuable resources.

The 2010 DFS briefing tour was tailored specifically for each unit visited in order to maximise the lessons learned. Stress points were provided by the Units and Wings prior to our arrival and reviewed during our visits to ensure accuracy and validity. Key flight safety issues were reported back to the Chief of the Air Staff office for awareness and action as necessary.

The revised preventive measures (PM) tracking process introduced in 2010 has started showing some dividends. PMs can now be tracked more efficiently through to the appropriate level in the CoC. Planned improvements to FSOMS such as realigned event descriptors and systems descriptors combined with quality control of occurrence data entry are intended to help us refine our trending and will contribute greatly to our proactive efforts to maximise safety and minimise incidents and accidents

DM Cundy, LCol

for D. B. Chicoyne
Colonel
Director of Flight Safety

EXECUTIVE SUMMARY

This report provides a synopsis of the activities carried out in 2010 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 12 investigations and closed 34. The investigations tasked by DFS were for 9 accidents (4 Cat 'A', 3 Cat 'B', and 2 Cat 'C'), 3 incidents (one Cat 'D' and 2 Cat 'E'). These figures include 3 Air Cadet (categorized non-CF) investigations and 1 investigation for a UAV accident.

Aeronautics Act Amendment. DFS/AIA re-assessed the requirement for an Aeronautics Act (AA) amendment and concluded that such an amendment remains the best vehicle for providing aviation safety investigators the appropriate powers necessary to conduct investigations concerning aviation safety, particularly when civilians are involved in the occurrences. Because the original proposed amendments were not re-introduced in the last sessions of Parliament (40th Parliament – 1st, 2nd & 3rd sessions), DFS checked with Transport Canada (TC) and were informed that AA amendment was no longer high on the TC priority list. DFS inquired if TC would support an AA amendment effort lead by the DND/CF, dealing primarily with augmenting safety investigator powers and received TC support for this initiative. Appropriate documents were forwarded to the MND with this theme, which received CDS and DM support; however, MND approval was not forthcoming prior to the dissolution of the current session of Parliament. DFS/AIA plans on pursuing this initiative with the new MND post the May 2011 election (41st Parliament).

Airworthiness Investigation Manual. The A-GA-135-003/AG-00 Airworthiness Investigation Manual (AIM) was published in Feb 2010 with the procedures and processes outlined in the manual coming into effect 15 Apr10. Over the past year, all DND/CF Flight Safety Officers and NCMs that were previously trained and qualified to conduct safety investigations in the Flight Safety Program have been AIA authorized and recorded as being so authorized. This was through an update process initiated and completed primarily through the Division Flight Safety Officer's span of control and secondarily through a documentation process conducted within DFS. All subsequent Airworthiness (Flight Safety) investigators trained through the Division Flight Safety training program have been appropriately AIA authorized through a delegation from the AIA to the Div Flt Safety Officer. As well, advanced investigator training and qualification documentation is in place and continues to be updated for all investigators within DFS. During the coming year the goal will be to amend Specialty Specification Codes and track these qualifications utilizing that tracking system and through individual UER updates. 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 #3 of the A-GA 135-001/AA-001, *Flight Safety for the Canadian Forces*, was released on 01 Mar 2010. The amendment covers changes relevant to the introduction of the AIM, a description of the FS strategic business model, the CVR/FDR parameter requirements by families of aircraft, the conditions required to carry out airworthiness investigations, amendments to the investigation class table, and illustrates the newly revamped occurrence/hazard PM management process. Amendment #4 of the A-GA 135-001/AA-001 was in draft form at the end of the year.

CVR/FDR Working Group. The CVR/FDR Working Group continued its activities during the reporting period but has progressed as far as it can without funding approval. Implementation policy will focus on achieving an average of one fleet per year for the next 10 years based on the agreed upon fleet prioritizations.

FLIGHT SAFETY PROGRAM

Promotion. DFS presented 41 annual briefings (33 English and 8 French) at 23 locations covering several Wings as well as the Canadian Contingent at Geilenkirchen, CDLS (London) and SHAPE HQ Belgium reaching approximately 7500 personnel. DFS met with over 75 Commanding officers and their Squadron warrant officers as well as visits to 8 Control Towers. DFS published 3 issues of *Flight Comment* magazine, 1 issue of *On Target*, which focussed on night operations, and 7 issues of the electronic FS newsletter *Debriefing*. There were no FS Flash messages released during 2010. A total of 33 FS award submissions for individuals or groups were considered resulting in the granting of 2 *Good Show*, 14 *For Professionalism* awards and 9 recommendations for Commanders Commendations.

Surveys. DFS conducted 4 FS surveys with contracted organizations: Cascade Aerospace Ltd in Abbotsford, AVEOS Fleet Performance in Montreal, IMP Aerospace Ltd in Halifax, and Standard Aero Ltd in Winnipeg. The flight safety staff at the division level (1 and 2 Cdn Air Div) conducted surveys of deployed Task Force air assets in Kandahar and Camp Mirage, 7 Air Wings, and the 3 CH149 Cormorant Sqns. A FS staff assistance visit (SAV) to CFB Edmonton and Camp Wainwright during air exercises 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 Sqn/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 4 Basic Flight Safety Courses were conducted by 1 Cdn Air Div FS staff. They qualified 111 personnel, including 6 Air Cadet staff members, 9 civilian contracted service providers, 1 person from Nav Canada, 1 Army member and 4 firefighters. They also conducted 1 Advanced Flight Safety Course which qualified 19 personnel, including 1 Nav Canada member and 3 civilian contracted service providers.

STATISTICS AND DATA ANALYSIS

Standard Deviation in Trend Analysis. The goal of this trending methodology is to highlight areas of concern based on expectations. When comparing 2010 with the previous 10 years, results are calculated as the difference of 2010 data from the 10-year mean expressed in standard deviation units (Deviation coefficient).

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

Flying Hours and Reporting. The overall number of hours flown in the CF, for the Air Cadet Glider Program (ACGP), and Unmanned Aerial Vehicles (UAV) has increased by 9% compared to 2009. Personnel reported 3,138 occurrences, of which 57% were classified as Air occurrences. This represents a reduction in the rate of reporting per 10,000 hrs (210.69 compared to 239.10 in 2009) and could indicate a deteriorating reporting culture.

Occurrences Breakdown. The CF had a less than favourable FS record. Although major and minor injuries decreased, (3 serious, 38 minor), a total of 3 aircraft were lost (2 CF188 Hornet and a CH147 Chinook). The Air accident rate for the CF was 0.88. This was attributable to 3 category 'A' accidents (2 CF188 Hornets, 1 CH147 Chinook) and 8 category 'C' accidents (1 CT145 King Air, 3 CT114 Tutors, 2 involved in the same accident, 1 CC130 Hercules, 1 CC130J Hercules, 1 CF188 Hornet, 1 CH146 Griffon, and 1 CH147 Chinook). This is greater than the 10-year average rate of 0.54, and marks the third consecutive year above the mean. The statistics for the Air Cadet program continue to show a significant increase compared to 2008 (3.42 vs. 1.94) and the previous 5-year mean (1.68). On a positive note, the UAV accident rate was 0.0.

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

- CC130. The CC130 Hercules is an aging fleet with 15 Open/Active RARMs. Propeller Low Oil Light indications will continue to be a concern with the legacy CC130 fleet. There are no other specific safety concerns at this time.

- CT114. There was a small increase in the flight instruments descriptor from the previous year. Although minimal, it did highlight an area of concern. The 2009 occurrence 139410 concerning a failure of the pitot static anti-icing system listed the following PM "Recommend normal fault monitoring for trend development". There were two similar occurrences in 2010 (143094 and 143095). The PM for these occurrences state that "The trend during the summer airshow season is to not completely verify this system is operating given its minimal use during airshow performances". This would be indicative of human factors rather than equipment failure.

Personnel Cause Factor.

- Human Factors Analysis and Classification System (HFACS). Following a review of HFACS routine/exceptional deviation entries conducted by DFS in conjunction with 1 Cdn Air Div FS staff, recommendations were made to better train our investigators. Additional syndicate work was done under the guidance of the DFS Flt Surgeon to identify ways to ensure quality control. The findings will be published when the work is completed.

- Preventive Measures. Efforts made in the last few years to track PM have led to improvements in the staffing process in terms of time to implement and record management of measures taken or decisions made. The number of outstanding recommended PM was reduced to 31 for the 2001-2007 period which is a significant reduction from the previous report (43 for the 2000-2006 period in the 2009 annual report). The PM tracking process is helping the CoC deal with the proposed measures and hopefully prevent recurrence.

TABLE OF CONTENTS

2010 FLIGHT SAFETY ANNUAL REPORT

1. AIRWORTHINESS PROGRAM

1.1 AERONAUTICS ACT UPDATE (2010-2011)

DFS/AIA re-assessed the requirement for an Aeronautics Act amendment and concluded such an amendment remains the best vehicle for allowing aviation safety investigators to have the appropriate powers to conduct investigations concerning aviation safety, particularly when civilians are involved in the occurrences. Because the original proposed amendments were not re-introduced in the last sessions of Parliament (40th Parliament – 1st, 2nd & 3rd sessions), DFS checked with Transport Canada (TC) and was informed that AA amendment was no longer high on the TC priority list. DFS inquired if TC would support an AA amendment effort lead by the DND/CF, dealing primarily with augmenting safety investigator powers and received TC support for this initiative. Appropriate documents were forwarded to the MND with this theme, and received CDS and DM support; however, MND approval was not forthcoming prior to the dissolution of the current session of Parliament. DFS/AIA plans on pursuing this initiative with the new MND post the May 2011 election (41st Parliament).

1.2 AIRWORTHINESS INVESTIGATIVE MANUAL

The A-GA-135-003/AG-00 Airworthiness Investigation Manual (AIM) was published in Feb 2010 with the procedures and processes outlined in the manual coming into effect 15 Apr10. Over the past year, all DND/CF Flight Safety Officers and NCMs that were previously trained and qualified to conduct safety investigations in the Flight Safety program have been AIA authorized and recorded as being so authorized. This was primarily through an update process initiated and completed through the Division Flight Safety Officer's span of control and secondarily through a documentation process conducted within DFS. All subsequent Airworthiness (Flight Safety) investigators trained through the Division Flight Safety training program have been appropriately AIA authorized through a delegation from the AIA to the Div Flt Safety Officer. As well, advanced investigator training and qualification documentation is in place and continues to be updated for the investigators within DFS. During the coming year the goal will be to amend Specialty Specification Codes and track these qualifications utilizing that tracking system and though individual UER updates. 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 4 FS surveys at contracted service provider sites (Cascade Aerospace Ltd in Abbotsford, AVEOS Fleet Performance in Montreal, IMP Aerospace Ltd in Halifax, and Standard Aero Ltd in Winnipeg) as part of the DFS continuous contracted service providers visit program. These surveys revealed that the maturity of the safety culture for some of these organizations is actually more evolved than that of the CF and could serve as an example to other organizations, including ours. FS staff at the division level (1 and 2 Cdn Air Div) augmented by DFS personnel conducted surveys of deployed Task Force air assets in Kandahar and Camp Mirage, seven Air Wings, and the three CH-149 Cormorant Sqns during the year. A FS SAV to CFB Edmonton and Camp Wainwright ISO air exercises was also done by the FS staff. 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 Sqn/Unit, along with specific recommendations for improving FS prevention programs with the aim of reducing risk and FS accidents or incidents.

1.4 WORKING GROUPS

1.4.1 CVR/FDR Working Group

Revised implementation timelines to the CVR/FDR policy, along with fleet prioritization were promulgated by CAS in Jun 2010. The CVR/FDR Working Group continued its activities during the reporting period but has progressed as far as it can without funding approval. The Director of Air Requirements is responsible for implementing the CVR/FDR policy, with the aim of adding CVR/FRD to an average of one fleet per year for the next 10 years, based on the agreed upon fleet prioritizations.

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

The 5th Flight Safety Occurrence Management System Working Group (FSOMS WG) was held mid-March 2010 at the National Defence Headquarters in Ottawa. The WG reviewed and accepted a prioritised list of FSOMS software bug fixes. The PM/Hazard tracking capability was added to FSOMS V3.0.5 and fielded Oct 2010. Event descriptors, Mission descriptors and System descriptors were discussed. The Ground environment, Property damage and Preventive measures categories pull-down menus were reviewed. A proposal for a FSOMS periodic wing level report was presented and a draft circulated to all wings.

The 6th FSOMS WG was held at the Ottawa Conference center on 8-9 November 2010. The prioritised list of FSOMS software bug fixes was reviewed and V3.0.6 items were identified. DFS continues to pursue the establishment of additional data sources beyond flying hours, such as numbers of landings/take-offs and maintenance man hours, to provide additional trending data. The event descriptors taxonomy proposal was refined for presentation at the annual seminar; results will be incorporated to FSOMS. The Ground environment, Property damage and Preventive measures categories pull-down menus review results were presented and accepted with minor changes. Modifications will be implemented and users will be notified once complete. The ability to enter and search SFCL data will be added. The FSOMS periodic wing report has been introduced and is in the testing phase. User comments have tailored the frequency and data output. Further refinements will occur after V3.0.6 release. FSOMS User account access privileges need to be revisited in order to control access to draft reports until they are officially released.

1.5 INVESTIGATIONS

1.5.1 Investigation Summary

During the calendar year, the AIA initiated 12 investigations and closed 34. The investigations tasked by DFS were for 9 accidents (4 category 'A', 3 Cat 'B', and 2 Cat 'C'), 3 incidents (one Cat 'D' and 2 Cat 'E'). These figures include 3 Air Cadet (categorized non-CF) investigations and 1 investigation for a non-CF UAV accident, Heron 255 in Suffield, as part of a cooperation agreement in place.

SERIAL	DATE	OCCURRENCE CATEGORY	DAMAGE	INJURY	AIRCRAFT	EVENT
CLASS I INVESTIGATIONS						
1	16 Jul 10	A	Destroyed	Nil	Non CF Heron	Crash on approach
2	23 Jul 10	A	Destroyed	1 Serious	Hornet	Loss of thrust at airshow
3	5 Aug 10	A	Destroyed	12 Minor 8 Nil 1 unknown	Chinook	Uncontrollable in-flight fire due to enemy action
4	18 Nov 10	A	Destroyed	Nil	Hornet	Crash on NVG approach
CLASS II INVESTIGATIONS						
5	9 May 10	B	Very Serious	Serious	Glider	Premature tow rope release
6	14 Jun 10	E	Nil	Nil	Sea King	Crane on approach path
7	16 Jun 10	B	Very Serious	Nil	Tow Plane	Ground loop on landing
8	18 Jun 10	E	Nil	Nil	Hawk / F-16	Near miss on battle break
9	19 Jun 10	B	Very Serious	Minor	Tow Plane	Nose-over on landing
10	01 Aug 10	C	Serious	Nil	Griffon	Stinger strike on landing
11	8 Nov 10	C	Serious	Nil	King Air	Gear collapse on landing
12	18 Dec 10	D	Minor	Nil	Cormorant	Uncommanded engine shutdown

Table 1 - List of 2010 AIA Initiated Investigations

1.5.2 Investigation Details

1.5.2.1 16 Jul 10, CU170 Heron 255, Accident, Cat 'A', Suffield, AB

The Non-CF mission consisted of a training flight to conduct Automatic Take-Off and Landing (ATOL) and Remote Auto-Landing Position Sensor (RAPS) landings. This was the second mission for the Unmanned Air Vehicle (UAV) but the first for the accident crew. The first mission was flown without incident.

The occurrence mission plan consisted of three circuits, including two RAPS approaches and one ATOL approach, concluding with a landing. On the overshoot from the second RAPS approach, the outboard flaps remained in the down position with the associated "Servo Flap Right/OTR Fail" warning. This phenomena is a known issue with the Heron fleet and a Service Bulletin (SB MCM-026-2010) had already been released in an attempt to solve the issue. Throughout the circuit both the UAV and the Advanced Ground Control Station (AGCS) experienced multiple intermittent navigation systems failures. On final approach, the student Air Vehicle Operator (AVO) noticed the UAV flying too low and informed the AVO instructor, who immediately directed the student AVO to initiate an override altitude command to climb. The instructor noticed that the student AVO made an error in the screen button selection and immediately took control and gave the altitude override command. The UAV configuration was changing for the climb configuration when the UAV hit an electrical pole just east of highway 884. The UAV burst into flame and crashed on the west side of highway 884 approximately 800 metres north of the main entrance to CFB Suffield.

Although the investigation is on-going, two preventive measures have been implemented. The AVO shall set the minimum value for the "AMSL Low Alt Warning" to the MAP waypoint altitude prior to conducting an ATOL approach; and in the event that a combination of dual DGPS and INS/GPS faults occur while on approach, the AVO should overshoot immediately and climb to a safe altitude. The AVO shall not commence an ATOL approach with these faults present.

The focus of the investigation is on navigation system failures and human factors concerning operations within a ground control station environment.

1.5.2.2 23 Jul 10, CF188738, Accident, Cat 'A', Lethbridge, AB

During an airshow practice at Lethbridge County Airport, Hornet CF188738 experienced a loss of thrust from its right engine while conducting a high alpha pass at 300 ft above ground level (AGL). Unaware of the loss of thrust but feeling the aircraft sink, the pilot selected military power on both throttles to arrest the descent. The aircraft continued to sink and the pilot selected afterburner on both throttles. The aircraft immediately began to yaw right and continued to rapidly yaw/roll right, despite compensating control column and rudder pedal inputs. At approximately 150 feet AGL and about 90 degrees of right bank, the pilot ejected from the aircraft. The aircraft continued to yaw/roll right with its nose descending in a tight right descending corkscrew prior to hitting the ground nose first.

The ejection and seat-man separation worked flawlessly but the pilot was injured when he touched down firmly under a stable chute. After landing, the parachute shroud lines became entangled around the pilot's left leg and the parachute re-inflated before it could be released, causing him to be dragged several hundred meters. The pilot was able to release the remaining Koch fittings just as members of the Sky Hawks, the Canadian Forces parachute demonstration team, arrived on scene to provide assistance. First aid was administered to the pilot who was subsequently transported to the Regional Hospital.

Field examination of the engines did not reveal any anomalies. Both engines were sent to the Quality Engineering and Test Establishment for a detailed inspection. Concurrently, photogrammetric analysis is taking place to ascertain certain flight and engine parameters which could not be recovered from the Advanced Memory Unit and other recording devices. Finally, modeling and simulation has been undertaken to better understand the factors (e.g., throttle splits, altitude) affecting the aircraft's recovery under various conditions. The on-going investigation is focussing on the loss of thrust experienced by the right-hand engine, the factors that precluded an in-flight recovery of the aircraft, and CF-18 demonstration pilot training.

1.5.2.3 05 Aug 10, CH147202, Accident, Cat 'A', Near Armarah, Afghanistan

Chinook CH147202 was conducting a sustainment mission that involved carrying coalition troops and supplies to military installations outside Kandahar Airfield (KAF). While flying at low altitude from the forward operating base (FOB) Masum Ghar to the Panjwaii District Centre in Kandahar Province Afghanistan, the aircraft was forced down due to an in-flight fire. The source of ignition is linked to insurgent fire directed towards the aircraft.

Immediately following the sound of a detonation, flames and black smoke entered the cabin from the left side of the open rear ramp. Inside the cockpit, the smoke began to hamper the pilots' visibility.

Approximately 30 seconds after the detonation, the aircraft touched down smoothly with 15 to 20 knots of forward speed and came to a stop within 300 ft. By now, the rear of the aircraft was engulfed in a massive fire so all the passengers had moved to the forward part of the cabin. Aircrew members and passengers exited the aircraft from emergency exits located at the front of the aircraft. The door gun mount could not be removed from the main cabin door and the obstruction slightly impeded the egress of personnel exiting via that door. Some personnel sustained minor injuries from the fire and/or during the egress via the emergency exits.

Since the occurrence, all CH147 Chinooks in theatre have been modified with a new gun mount which incorporates a quick release function that allows it to swivel and be pushed out of the way during egress.

The scope of the on-going Flight Safety investigation will be limited to the survival aspects of this occurrence. The investigation will be focusing on the effectiveness of aviation life support equipment (ALSE) and on egress procedures, as well as passenger safety.

1.5.2.4 17 Nov 10, CF188789, Accident, Cat 'A', Near Cold Lake, AB

The single seat CF188 was flying as the second aircraft in a two-aircraft formation on a Night Vision Goggles (NVG) training mission. The prevailing weather was instrument meteorological conditions (IMC) and the accident occurred at night. During a radar trail instrument approach to runway 13L at Cold Lake, Lead called for the landing gear to be selected down. Upon selection of the landing gear, the wingman was almost immediately disoriented by the sudden rush of falling snow as it was illuminated by his landing light, which also reflected enough light through his Head Up Display (HUD) to washout the instrument references he used to control the aircraft. As a result of the visual inputs, the pilot perceived that he had entered a steep descent. In response, the pilot made an aft stick input and pulled the aircraft into a nose-high attitude. Still feeling that he was in a dive and thinking he was rapidly approaching the ground below, but unable to confirm his attitude using outside references or his HUD, the pilot decided to eject.

The ejection was successful and the parachute landing in a forested area was uneventful. The aircraft crashed in a nose-down, near wings level attitude and was destroyed. The uninjured pilot activated his personal locator beacon and used flares to direct the Search and Rescue helicopter to his location. The pilot was transported back to 4 Wing Cold Lake two and one half hours after his ejection.

A review of the recorded flight data and pilot testimony indicated that the aircraft was serviceable and operating normally. A preliminary review of operator practices determined that CF188 aircraft at the time of the accident were routinely operating on NVGs in IMC and at an unlit airfield, however, neither are authorized in accordance with Division Flying Orders.

The pilot was inexperienced in night flying and it had been 224 days since his previous NVG training mission. 1 Canadian Air Division has directed that CF188 NVG training now commence only after a pilot has increased flying experience.

The investigation also found numerous anomalies in the aircraft life support equipment practices and record keeping. Also noted, although not related to the accident, were areas of inconsistency in maintenance practices dealing with CF188 inlet icing cautions and de-icing procedures.

The on-going investigation is focussing on the human factors surrounding the occurrence. This will include disorientation, organizational pressures and training practices

1.5.2.5 9 May 10, Schweizer SGS 2-33 C-FBJH, Accident, Cat 'B' , Debert, NS

Schweizer SGS 2-33 Glider incurred very serious damage after a hard landing during an Air Cadet familiarity flight. The aircraft was crewed by a qualified Cadet Organizations Administration and Training Services (COATS) glider pilot in the back seat and an Air Cadet passenger in the front seat. The day involved numerous familiarization glider flights for members of a local Air Cadet squadron. Launches were conducted via auto-tow procedures using a pickup truck.

The occurrence happened on the last planned flight as the weather began to deteriorate with isolated rain showers.

As the glider began its take-off roll, the wing walker, holding up the left and into-wind wing, inadvertently dropped the wing after a few paces. Although the outer wing wheel contacted the ground, the glider pilot was able to level the wings before the glider became airborne. Correcting for the left crosswind, the glider pilot allowed the aircraft to drift left of the runway, just over the grass. The initial left wing drop, followed by the left drift, gave the Observer in the auto-tow vehicle the impression that the launch profile was unsafe, prompting a decision to abort the launch by releasing the tow rope. The consequences of releasing the glider at a low altitude were not considered and the assumption was made that the pilot would simply land straight ahead. However, at that altitude there was no time for the pilot to recover the aircraft into a gliding attitude. The combination of a nose high pitch attitude, low altitude and sudden loss of forward speed caused the glider to stall and land hard on its main wheel and nose skid. The glider pilot sustained minor injuries and the cadet passenger, in the front seat, sustained serious injuries.

The investigation revealed that although all Air Cadet personnel are encouraged to call a “stop launch” when they observe a situation that may pose a hazard, within their training there was no delineation between ground or air hazards. Although the observer acted in accordance with standard procedures in reacting to a perceived risk, the decision to release at that critical point of flight left no time for the pilot to recover safely. It was clear that once an aircraft is airborne, only the pilot is in a position to determine the controllability and safety of the aircraft and whether continuing a launch poses a greater risk than aborting.

Recommendations were therefore made to enhance the training provided to cadets with clear direction and set limitations on when ground personnel can decide that a launch should be aborted. The investigation is on-going.

1.5.2.6 14 Jun 10, CH12416, Incident, Cat 'E', Shearwater, NS

On 14 Jun 2010, the crew flying CH12416 was returning from Greenwood under an Instrument Flight Rules (IFR) flight plan. After descending below a layer of cloud for a TACAN approach, the check pilot observed a newly erected construction crane that appeared to breach the safety boundary of the instrument approach corridor to runway 16. During the next approach, a Precision Approach Radar (PAR), the

check pilot concerns with the crane's height and proximity escalated due to slightly different path taken for the approach. The crane was not illuminated and no Notice to Airman (NOTAM) had been issued for it.

Following the occurrence, 12 Wing Ops directed that no IFR approach to Runway 16 would be conducted until validation of the Terminal Instrument Procedures (TERPs) calculations and confirmation of the acceptability of the new specifications for approaches by the Wing Instrument Check Pilot. It was determined that the safety boundary was breached by about 30 feet and the TERPs by 19 feet. Once the TERPs were validated and the new specifications for the approaches were confirmed as acceptable, 12 Wing made NOTAM submissions that were immediately issued by NAV CANADA.

The crane was erected for the construction of a four-storey building. An assessment had been conducted by the Halifax Regional Municipality, CFB Halifax, and 12 Wing Shearwater for the issuance of a building permit. As the plans showed that the completed structure did not encroach on the safety boundary, the proposed construction was deemed acceptable; however, the building plans did not include details about temporary structures (i.e., the crane) required during the construction. As a result of the missing information, the review did not identify the encroachment to the safety boundary.

The occurrence could have been prevented if a "Land Use Proposal" had been submitted to NAV CANADA prior to the erection of the construction crane. The investigation revealed that not all land developers and crane companies know about the requirement to submit a Land Use Proposal. This lack of awareness may be because the submission of the Land Use Proposal is not mandatory but also because DND policies and guidance material related to the review of construction permits and the erection of construction crane in the vicinity of any military aerodromes are not readily available.

To prevent future occurrences of this type, it is paramount that policies and guidance material be developed for the enforcement of the zoning regulations. It is also important that stakeholders be made aware of the information to be provided, and the approval process, for the installation and operation of a crane in the vicinity of military aerodromes. The investigation is on-going.

1.5.2.7 16 Jun 10, Cessna L-19 C-FTAL, Accident Cat 'B', Courtenay Air Park, BC

On 16 Jun 2010 at approximately 1300 PDT, C-FTAL, a Cessna L19E (305C) was being flown on an Annual Proficiency Check (APC). The Aircraft Captain/Check Pilot (CP) was in the rear seat and the Pilot Flying (PF) was in the front seat. As part of the APC profile, the PF completed air work in the training area near Constitution Hill and returned for circuit work to Courtenay Air Park (CAH3). On initially overflying the

airfield, both pilots observed the windsock and determined that the wind was light and favouring Runway 31 with a right crosswind of less than 90 degrees. The PF joined the left hand circuit and configured the aircraft for a planned touch-and-go landing. The traffic pattern checklist was carried out and flaps were set at approximately 40 degrees. On final approach, both pilots again assessed the winds and noted that they had shifted slightly to a 90 degree crosswind. Both were comfortable that the wind was well within normal parameters for landing. The PF continued the approach and touched down in the first quarter of the runway. As the aircraft settled onto the runway it veered to the left of the centreline coming to within one meter of the edge of the pavement. The PF applied corrective flight control inputs to bring the aircraft to the right and back to the centreline. The aircraft responded appropriately and began to turn right; however, the turn rate accelerated beyond that expected by the PF. He applied left rudder and left brake aggressively to attempt to control the right swing; however, despite all efforts, his reaction was too late. He lost directional control and the aircraft entered a right ground-loop. As the turn progressed through approximately 90 degrees the left wheel axle mounting bolts failed in overload and the left wheel and brake assembly departed the aircraft striking the underside of the left wing on the way. Subsequently, the left-hand landing gear strut penetrated the asphalt runway surface and acted as a horizontal and vertical pivot point for the aircraft. The left wing tip and left elevator tip contacted the ground and the aircraft continued to rotate through approximately 220 degrees of initial heading before coming to rest.

Initial damage assessment revealed structural damage to the left wing, elevator, landing gear, landing gear box structure, engine mounting structure and possibly the rear fuselage.

The investigation is closed. Recommended preventive measures included the validation of Weight and Balance and Centre of Gravity charts for all L19 aircraft and improved training to provide crews better awareness of ground loop dynamics, aggravating factors, and prevention strategies.

1.5.2.8 18 Jun 10, CT155 Hawk and F-16,Incident, Cat 'E', Cold Lake, Al

The near miss occurred when a single F-16 from a visiting force flew over the inner runway, where a CT155 formation was completing an “in stream” touch and go. The F-16 pilot requested a battle break to the outer runway but incorrectly aligned his aircraft over the inner runway. During the run-in, the maximum speed of the aircraft was inadvertently exceeded. ATC had cleared the F-16 pilot for a battle break to the outer runway even though battle breaks were not authorized for single aircraft. The F-16, now moving at 580 knots, flew 200’ above the number two CT155, which had just lifted off the runway from a touch and go. Midway down the runway, the F-16 pilot was surprised to sight the lead CT155 aircraft airborne and in his flight path. To avoid the lead CT155 aircraft, the F-16 pilot entered a hard right climbing turn, resulting in a g limit exceedance to his aircraft. Once clear of the conflict, he rejoined to the outer runway, where he further over stressed his aircraft while extending the landing gear.

The F-16 pilot was a qualified wingman at the end of his first week on the exercise. He had never flown a battle break before nor had he received any additional instruction on how to complete the manoeuvre. The F-16 pilot mistakenly believed the battle break was to be flown over the inner runway for a break to the outer runway. In addition, he intended to fly his aircraft as fast and as low as limits would allow.

During the pilot's in-briefing, 4 Wing personnel verbally described a battle break and encouraged the visiting pilots to do it. The battle break was not a recognized procedure in the occurrence pilot's home country and numerous questions were asked regarding the procedure during the briefing. The briefing did not depict any diagrams of the battle break because aircrew had previously critiqued the ATC briefing for being too lengthy. As well, the In-Flight-Guide issued to the visiting pilots did not provide any details of the battle break, although pilots were directed to consult the local flying orders.

To prevent the likelihood of a re-occurrence, a number of administrative changes were made by 4 Wing and the visiting force. Fundamentally, however, the occurrence was a result of the F-16 pilot's misplaced aggressiveness and sole reliance on his recall of how to perform the manoeuvre. The pilot has subsequently reflected on the constant requirement to exercise judgement and maintain air discipline.

1.5.2.9 19 Jun 10, Cessna L-19 C-FTGF, Accident Category 'B', Comox, BC

The occurrence happened during tow plane operations in support of Regional Gliding School (Pacific) glider operations at the Comox Airport. The active landing surface in use was taxiway Alpha 30. The weather was good with Tower reporting surface wind of 010 degrees magnetic at 7 knots, resulting in a 6 to 7 knot crosswind from the right. The crosswind limit for the L-19 is 10 knots.

The aircraft had already completed multiple circuits and the approach to landing and initial touchdown were uneventful. On touchdown, the aircraft began to yaw to the right due to the crosswind. The occurrence pilot initially countered the yaw with rudder, and as the aircraft continued to yaw, attempted to correct with brake application. The aircraft began to pitch forward, eventually causing the propeller to strike the runway. It then continued over on its nose and flipped over, coming to rest in an inverted position.

The pilot sustained minor injuries and safely egressed the aircraft. The aircraft was damaged beyond economical repair.

The investigation focused on pilot experience, the program for tow plane conversion training, and the techniques required to control the L-19 during the landing phase.

The investigation concluded that the pilot had inadvertently released back-pressure on the stick while focusing on the maintenance of directional control with the rudder and brakes. The relaxation of back-pressure in combination with the strong brake application resulted in a nose down pitch force that the pilot was unable to counter.

The pilot had recently completed the tow plane training program with no significant difficulties. He was highly experienced in tricycle type gear equipped military aircraft but had very limited experience on tail wheel aircraft. While it is normal to release stick back pressure during landing on a tricycle gear aircraft, this action reduces yaw control authority in tail wheel aircraft. It is likely that he subconsciously reverted to his previously ingrained tricycle gear habits and inadvertently released the aft stick force on the aircraft.

This occurrence has been reviewed by the unit as well as standards officers throughout the tow plane community. All pilots in the unit were briefed on the potential for control difficulties during crosswind landings. The training syllabus is being reviewed for a possible increase in the number of dual sorties required to become qualified with a focus on crosswind landing training.

1.5.2.10 01 Aug 10, CH146425, Accident, Cat C, KAF, Afghanistan.

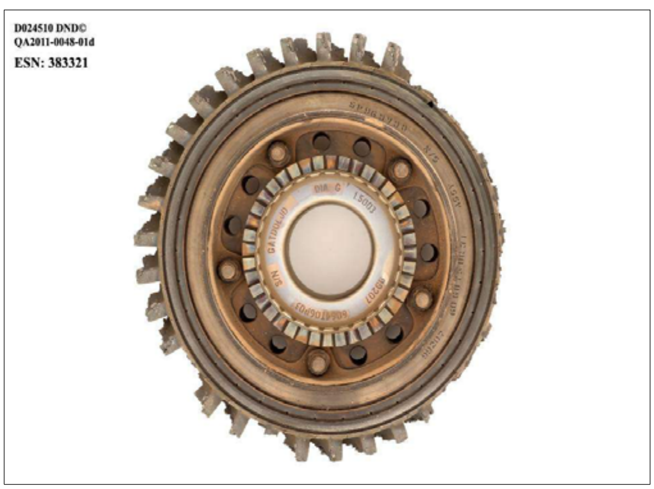
During final approach to the FARP, the number two aircraft of a formation of CH146 helicopters experienced an unusual landing during which the stinger struck the ground. The pilot turned 90 degrees to the left during the short final phase resulting in a 90 degree crosswind from the right. At that point the helicopter began a descent from a height of about 20 ft and bounced on the gravel a few times before skidding a distance towards the refuelling parking spot. During the second bounce the aircraft tail boom stinger hit the ground damaging one tail rotor blade in the process. There were no injuries. The investigation is ongoing.

1.5.2.11 08 Nov 10, CT145/CFMFR, Accident, Cat 'C', Portage La Prairie, Manitoba

A CT145 King Air departed the hard surface of the runway at Portage la Prairie as the aircraft was performing a full stop. The aircraft was crewed by a Qualified Flight Instructor (QFI) in the right seat and a student pilot, under training as part of the Multi-engine Pilot Course, in the left.

Immediately after touchdown, the right wing began to sink due to failure of the right main landing gear. Attempts to maintain runway centreline proved futile as the aircraft drifted right, departing the hard surface of the runway approximately 600 meters after touching down. The aircraft came to a full stop at the crest of a drainage ditch, 78 meters right of runway centreline. The right main landing gear was collapsed and forced aft, angled down the slope of the ditch. Both pilots were able to safely egress with no injuries. The aircraft sustained damage. The evidence indicates that the right landing gear collapsed when the drag brace bolt failed due to a pre-existing fatigue crack. This investigation is ongoing.

1.5.2.12 18 Dec 10, CH149907, Air incident, Cat 'D', 55Nm NNE of Comox, BC



Approximately 35 minutes into the outbound transit phase of a Search and Rescue mission, at 9400 MSL in level cruise at maximum continuous power, the number three engine failed. The aircraft commander immediately took control and started a turn back towards Comox. The flight engineer and first officer followed the prescribed emergency procedures to secure the engine. A run-on landing was conducted at Comox airport without further incident.

A borescope and subsequent teardown inspection revealed that a single stage 1 blade had separated from the shank below the platform. The blade separation was the result of fatigue cracking due to a combination of corrosion and damper distress. The investigation is ongoing.

1.5.3 <u>Investigation Report Status</u>

1.5.3.1 Table 2 outlines the status of ongoing investigations as of 31 Dec 2010. Definitions for SR, ESR, and FSIR can be found in terminology article 5.2.

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
30 Aug 07	CH149903	Main rotor head damaged during ground maintenance	ESR being staffed
31 Oct 07	CH149902	Extensive wear damage on swash plate found on daily inspection	ESR being staffed
19 Jan 08	CH146488	Near rollover and over torque	FSIR being staffed
18 Apr 08	CT155215	Engine failure during climb out and double ejection	Draft FSIR being staffed
06 Sep 08	C-GQYY	Premature rope release.	FSIR being staffed
30 Apr 09	CH146000	CH146 KAF exceedences	ESR being drafted
08 May 09	SAR TECH	Fouled Parachute	Draft for comment
28 Jul 09	CH149910	An 18-inch crack found on MGB	FSIR being staffed
06 Jul 09	CH146434	Aircraft crashed on departure	FSIR being drafted
05 Aug 09	C-GCSK	Glider hit trees on final approach	ESR being staffed
13 Aug 09	CT156101	Near collision	FSIR being staffed
06 Sep 09	C-FNWO	Glider hard landing	FSIR being staffed
17 Nov 09	CF188925	Training round lands app 50 feet from ground personnel	Prelim FSIR being staffed
26 Nov 09	CC115465	Structural damage while refuelling	Prelim FSIR being staffed
14 Jun 10	CH124416	Crane encroaching Final Approach sector	ESR out for comments
16 Jul 10	HERON 255	UAV hit telephone pole	Draft for comment in progress
23 Jul 10	CF118738	Aircraft crashed - pilot ejected successfully.	Draft for comment in progress
01 Aug 10	CH146425	Stinger strike on final to FARP.	ESR in progress
05 Aug 10	CH147202	Aircraft shootdown in theatre	Draft for comment in progress
08 Nov 10	C-FMFR	Gear collapse on landing	Draft for comment in progress
18 Nov 10	CF118789	Crash on approach	FTI for signature
18 Dec 10	CH149907	No. 3 engine failure	Investigation on-going

Table 2 - Ongoing Investigation Report Status

1.5.3.2 Table 3 outlines the investigations that were closed during 2010.

ACCIDENT DATE	AIRCRAFT	DESCRIPTION	INVESTIGATION CLOSURE DATE
19 Oct 09	CT155204	Tailplane nose-down trim run-away	12 Jan 10
13 May	CC130325	SAR Tech injured.	13 Jan 10
07 Jul 08	CF188931	Engine flamed out due to low fuel	19 Jan 10
05 Mar 09	CF188730	APU Started without exhaust duct	02 Feb 10
03 Nov 07	CH146437	Truck contacted Main rotor of parked aircraft	24 Feb 10
16 Oct 08	CH149915	Main rotor strike	09 Mar 10
08 Jul 09	CC130328	Parachute malfunction.	12 Apr 10
14 Oct 09	RN ZH837	Aircraft damaged during deck landing	23 Apr 10
27 Jul 08	CH149909	T/R drive vibrations	23 Apr 10
19 Oct 09	CH146441 / CH146479	Runway incursion	11 May 10
24 Jan 10	CH147204	FE injured on landing	19 May 10
28 Jan 09	CH146470	Main rotor strike	30 Jun 10
09 Oct 08	CT114065	Controlled Flight into terrain	07 Jul 10
07 Jul 09	CC130328	SAR Tech Injured	05 Aug 10
08 Mar 07	CF188744 / CF188749	Near miss	31 Aug 10
04 Feb 09	CT155205	Turbine blade loss	02 Sep 10
16 May 07	CF188720	Engine Failure	20 Sep 10
18 Jan 09	CH147204	Droop stop failure	13 Oct 10
28 Apr 07	CH149902	Engine #3 Sprag clutch failure	02 Dec 10
19 Jun 10	C-FTGF	Pitch over on landing	06 Dec 10
12 Jun 09	CT114145	Seat belt failure	09 Dec 10
22 Sep 09	CH146425	Hard landing	13 Dec 10

DATE	AIRCRAFT	DESCRIPTION	SR RELEASED in FSOMS
05 Mar 08	CU161019	Collision with excavating equipment, destroyed	06 Apr 10
17 Nov 07	CU161017	Catastrophic engine failure	27 Apr 10
22 Aug 08	CU161030	Crash due to engine power failure, post-crash fire, aircraft destroyed	27 Apr 10
25 Oct 08	CU161017	Engine failure - UAV crashed	27 Apr 10
06 Nov 08	CU161031	Engine failure - UAV crashed	04 May 10
24 May 08	CU161016	Prop strike on launch UAV crashed	07 May 10
28 Jan 09	CH146470	Main rotor blade contacted trees	10 May 10
16 Jun 10	C-FTAL	Ground loop on landing	25 Aug 10
01 Nov 07	CU161001	UAV crashed due to failed automated recovery	10 Jun 10
14 Mar 09	CU161016	Controlled flight into terrain	13 Sep 10
28 Jul 08	CU161017	Communication failure, returned to KAF, crashed	01 Oct 10
06 Apr 08	CU161017	Engine power loss and uncommandded descent, UAV crashed out of control	08 Feb 10

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. Forty-one FS presentations (33 English, 8 French) were given to several Wings (1 Wing, 4 Wing, 5 Wing, 8 Wing, 9 Wing, 12 Wing, 14 Wing, 15 Wing, 16 Wing, 17 Wing, 19 Wing and 22 Wing) and certain units (430 Sqn, 408 Sqn, 440 Sqn and CFSACO) in addition to the Canadian Contingent at Geilenchirchen, CDLS (London) and SHAPE HQ Belgium, for a total of 23 units totalling approximately 7500 personnel. We met with over 75 Commanding Officers and their Squadron Warrant Officers and visited 8 Control Towers. DFS published 3 issues of *Flight Comment* magazine and 1 issue of *On Target*, which focussed on night operations. A total of 7 issues of the electronic FS newsletter *Debriefing* were released. There were no FS Flash messages released during 2010.

2.2 AWARDS

A total of 33 FS award submissions for individuals or groups were forwarded to DFS / 1 Cdn Air Div FSO, resulting in the granting of 2 *Good Show* and 14 *For Professionalism* awards. An additional 9 nominations were recommended for a Unit\Wing Commander's Commendations. When compared to the previous reporting period, there were 3 additional award nominations submitted although the total number of awards granted decreased by 5.

2.3 TRAINING

A total of 4 Basic Flight Safety Courses were conducted by 1 Cdn Air Div FS staff. They qualified 111 personnel, including 6 Air Cadet staff members, 9 civilian contracted service providers, 1 Nav Canada member, 1 Army member and 4 CF firefighters. They also conducted 1 Advanced Flight Safety Course which qualified 19 personnel, including 1 Nav Canada member and 3 civilian contracted service providers.

3. STATISTICS AND TREND ANALYSIS

3.1 GENERAL

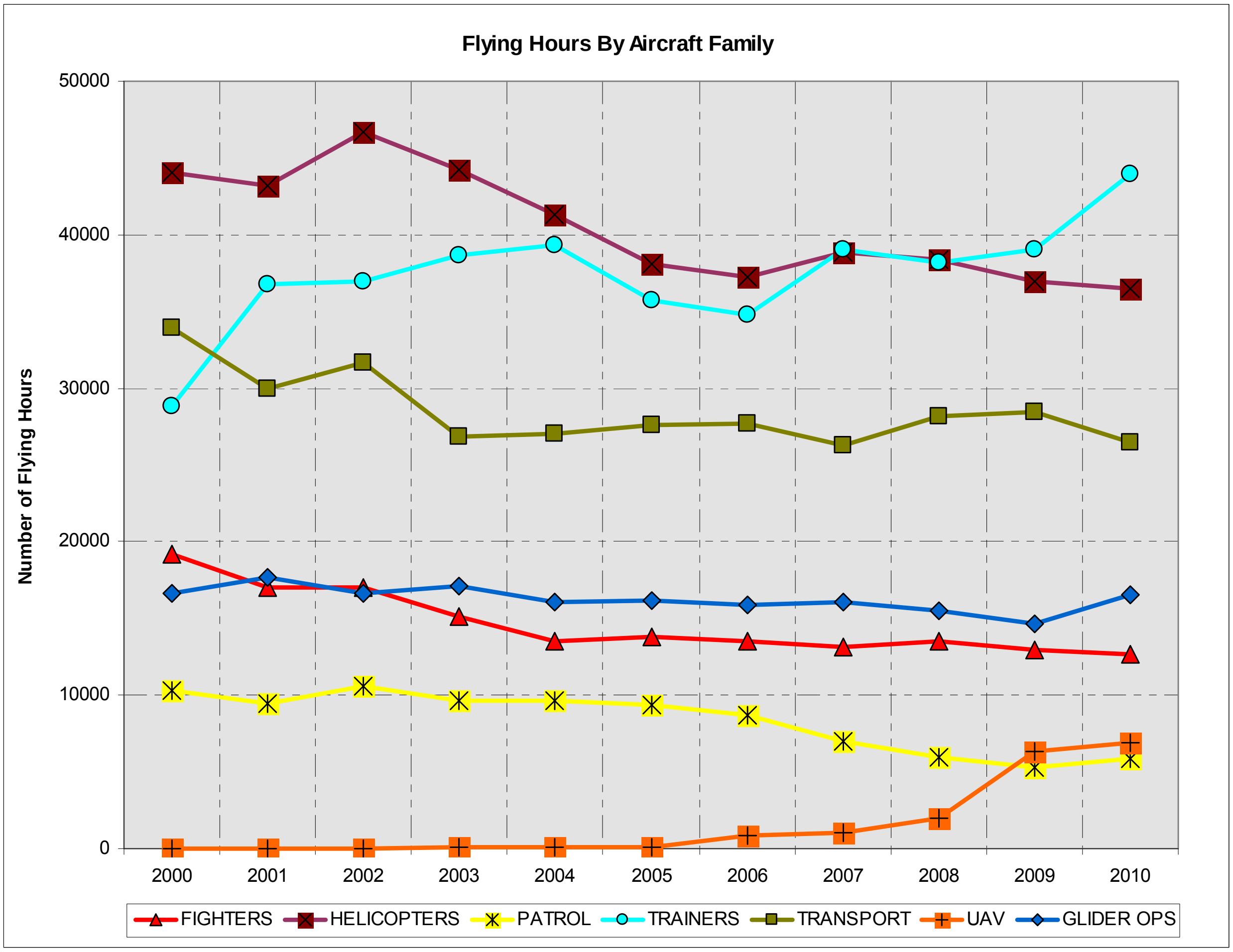
Rates are calculated per 10,000 flying hours, except for cause factors and HFACS data, which is reported per 1000 occurrences. Data is classified according to the colour code shown below. The colour is derived from the difference between the 2010 value and the 10-year mean (unless otherwise stated), in multiples of the standard deviation. For any negative trend having a D value greater or equal than 3, it is colour-coded maroon. It represents values of highest concern (Warning) and 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 have increased from 129,008 in 2009 to 148,937 in 2010: a 3.07% increase. This was due mainly to an increase in some trainer hours (CT102, CT145A, CT155, CT156) and UAV hours which was offset by a slight overall reduction in the Transport fleet hours (decrease of CC130 hours and increase of CC130J and CC 177 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

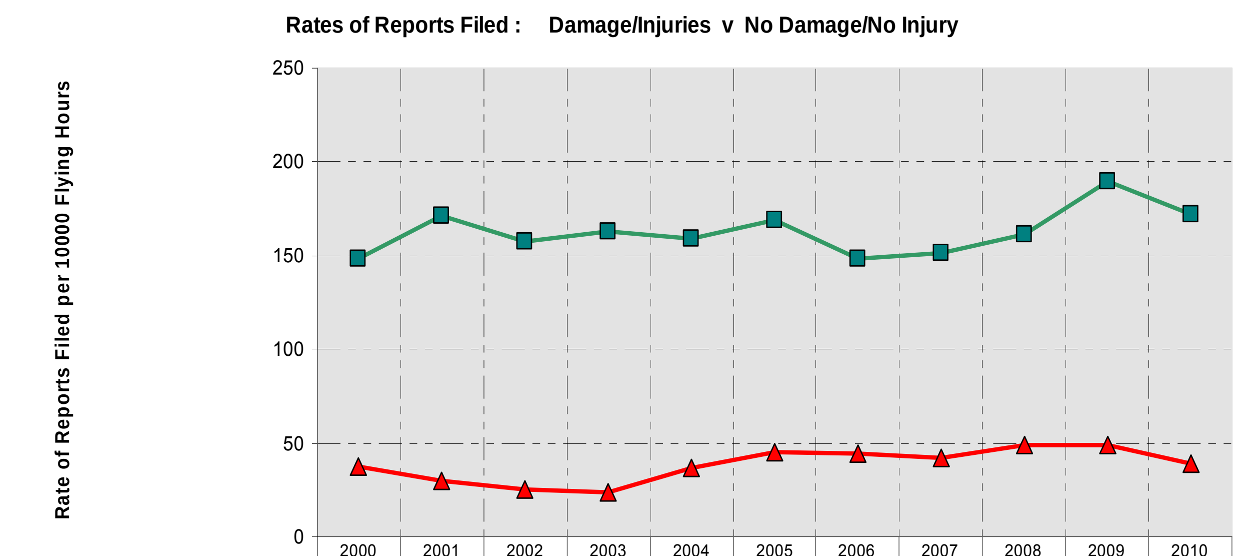
FLYING HOURS	00	01	02	03	04	05	06	07	08	09	10
FIGHTERS	**19188**	**16967**	**17004**	**15126**	**13476**	**13836**	**13546**	**13142**	**13497**	**12980**	**12699**
CF116	130	116	68	18	0	0	0	0	0	0	0
CF188	19058	16851	16936	15108	13476	13836	13546	13142	13497	12980	12699
HELICOPTERS	**44068**	**43197**	**46725**	**44212**	**41316**	**38099**	**37270**	**38884**	**38406**	**36958**	**36496**
CH113	6306	5366	4040	1626	464	0	0	0	0	0	0
CH124	9008	10576	10546	8226	8487	6857	6944	7628	7984	7830	7691
CH139	6121	6527	6666	6070	6371	5024	4613	4852	5684	1863	1834
CH146	22633	20489	22277	23384	21426	21632	21150	21465	19661	20332	19069
CH147	0	0	0	0	0	0	0	0	4	2058	2743
CH149	0	239	3196	4906	4568	4586	4563	4939	5073	4875	5159
PATROL	**10342**	**9418**	**10554**	**9684**	**9642**	**9324**	**8704**	**7012**	**5952**	**5324**	**5823**
CP140	10342	9418	10554	9684	9642	9324	8704	7012	5952	5324	5823
TRAINERS	**28847**	**36784**	**36974**	**38656**	**39314**	**35745**	**34741**	**39022**	**38210**	**38996**	**43989**
CT102	0	0	0	0	0	0	2118	3805	4898	5817	7049

FLYING HOURS	00	01	02	03	04	05	06	07	08	09	10
CT111	3879	4073	3230	2994	4163	3079	0	0	0	0	0
CT114	12508	3477	4088	3894	3903	3757	4101	3912	3926	3867	3623
CT133	3116	5122	1586	448	336	74	0	0	0	0	0
CT142	2265	2259	2304	2328	2446	2660	2760	2483	2059	1931	1858
CT145	4274	3708	3951	4771	5079	3271	2141	3381	3087	3425	3411
CT145A	0	0	0	0	0	0	0	0	0	763	1371
CT146	0	0	0	0	0	38	93	67	980	2719	3587
CT155	592	5128	7342	8383	8446	9137	8806	8714	6706	5836	7042
CT156	2213	13016	14474	15838	14942	13728	14722	16661	16554	14639	16049
TRANSPORT	**33889**	**29964**	**31708**	**26879**	**27007**	**27599**	**27741**	**26303**	**28191**	**28446**	**26506**
CC115	2967	2316	2120	2439	1839	2533	2065	1762	1703	1601	1751
CC130	20716	17902	19308	14945	15839	15442	16486	14870	14359	13963	10776
CC130J	0	0	0	0	0	0	0	0	0	0	742
CC138	2758	2455	1856	1923	1834	1962	1581	2166	2165	1830	1874
CC142	488	0	0	0	0	0	0	0	0	0	0
CC144	2881	2963	3157	2812	2979	2815	2706	2445	2712	3095	2815
CC150	4079	4328	5267	4760	4516	4847	4903	4483	4666	4402	4497
CC177	0	0	0	0	0	0	0	577	2586	3555	4051
UAV	**0**	**0**	**0**	**55**	**117**	**141**	**876**	**1031**	**1994**	**6304**	**6913**
CU161	0	0	0	55	117	141	876	1031	1725	883	0
CU170	0	0	0	0	0	0	0	0	269	5421	6913
CF TOTAL	**130954**	**136330**	**142965**	**134618**	**130872**	**124744**	**122878**	**125394**	**126250**	**129008**	**132426**
GLIDERS	**18049**	**16590**	**17634**	**16662**	**17068**	**16033**	**16149**	**15895**	**16050**	**15487**	**16511**
GRAND TOTAL	**154383**	**152920**	**160599**	**151274**	**147940**	**140777**	**139027**	**141289**	**142300**	**144495**	**148937**

Table 4 – Flying Hours by Aircraft Family and Type

3.2.2 Reporting of Occurrences

From Graph 2, a total of 3138 occurrences were reported; of these 57.09% were Air occurrences and the remaining 42.91% were Ground occurrences. This represents a 9% reduction in reported occurrences compared to the previous year (3455) but is above the 10-year mean value of 2946. Similarly, the occurrence-reporting rate has also decreased to 210.69 compared to 239.10 in 2009. The Damage/Injury –related occurrence rate has decreased to 38.8 just slightly above the 10 year mean of 38.1. The No Damage/No injury rate has decreased to 171.9 and is above the 10 year mean of 148.3.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Damage/Injuries Rates	37.1	29.8	25.4	23.7	36.4	45.2	44.2	42.0	48.6	49.1	38.8
No Damage/No Injuries Rates	148.4	171.4	157.8	163.2	158.8	169.1	148.2	151.5	161.0	190.0	171.9
Total Number of Occurrences	2864	3077	2942	2827	2888	3017	2674	2735	2982	3455	3138

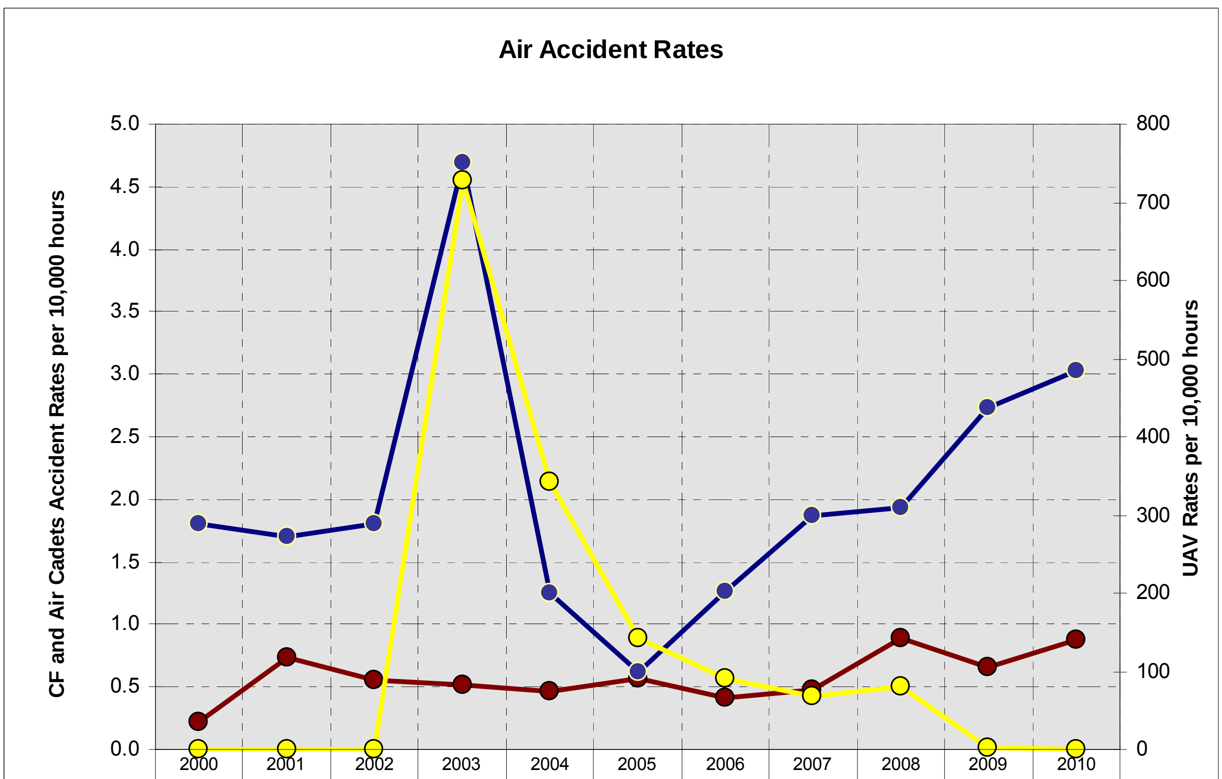
Graph 2 – Rates of Reports Filed Damage/Injury vs No Damage/No Injury

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 compared to 2009 (0.88 vs 0.65), and remains much higher than the 10-year mean (0.54). The breakdown of air accidents was 3 category 'A' accidents (2 CF188 Hornet, and 1 CH147 Chinook) and 8 category 'C' accidents (1 CT145 King Air; 3 CT114 Tutors, two involved in the same accident; 1 CC130 Hercules; 1 CC130J Hercules; 1 CF188 Hornet; 1 CH146 Griffon; and 1 CH147 Chinook. The UAV air accident rate for 2010 was .0 (Graph 3).

The Air Cadets accident rate has significantly increased since 2008 (3.03 vs 1.94).This rate is well above the previous 10-year mean (1.69)at Table 5. The 2010 accident rate is based on three accidents; two involved a ground loop, while the third occurred during an aborted take-off. In 2010, DFS recommended that D Cadets consider 2 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.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
CF Rates	0.22	0.73	0.56	0.52	0.46	0.56	0.41	0.48	0.89	0.65	0.88
Cad.Rates	1.81	1.70	1.80	4.69	1.25	0.62	1.26	1.87	1.94	2.73	3.03
UAV Rates	0.00	0.00	0.00	727.27	341.88	141.84	91.32	67.90	80.24	1.59	0.00

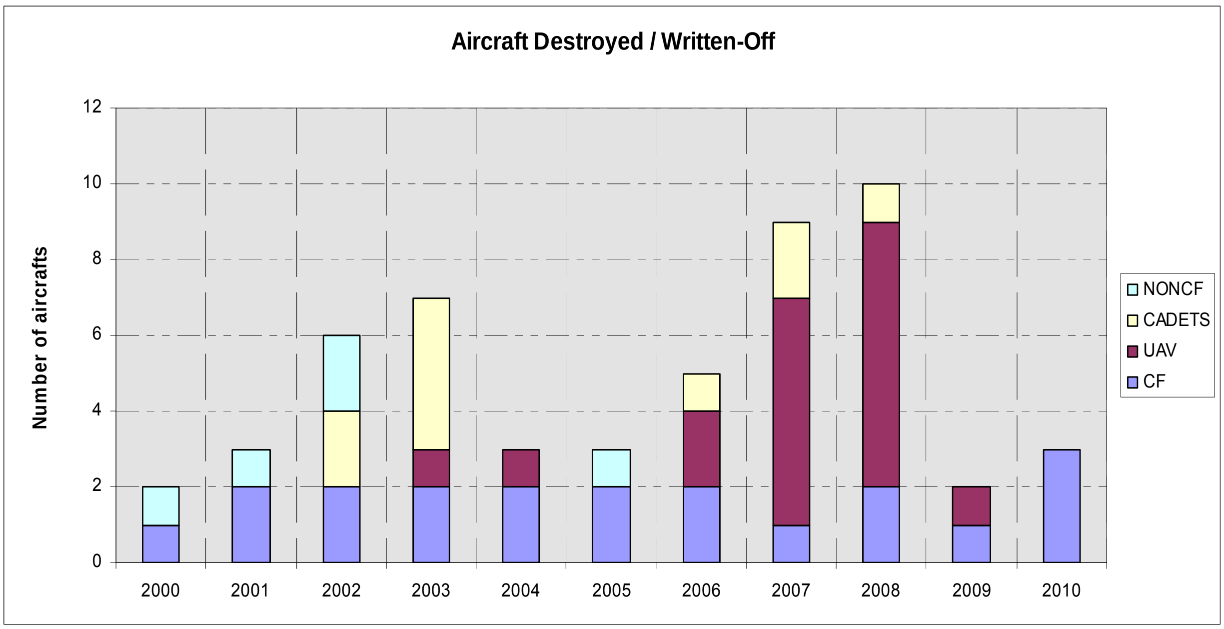
Graph 3 – Air Accident Rates
Note: 2003 Cadet outlier value discounted for the purposes of 10 year mean

Air Accident Rates	09	05-09 Mean	05-09 SD	10	D
CF Rates (Excluding Cadets and UAVs)	0.65	0.60	0.18	0.88	1.37
Cadets Rates	2.73	1.68	0.79	3.03	1.70
UAV Rates	1.59	76.58	50.47	0.00	-1.52

Table 5 - Air Accident Rates

3.2.3.2 Aircraft Destroyed/Written-Off

Three aircraft were destroyed, both in country and deployed to theatre of operations (2 CF188 Hornet and 1 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.



Graph 4 – Aircraft Destroyed / Written-Off

Note: 2010 Heron 255 UAV accident cooperation investigation not included to DFS statistical analysis.

AIRCRAFT	00	01	02	03	04	05	06	07	08	09	00-09 Mean	00-09 SD	10	D
CF	1	2	2	2	2	2	2	1	2	1	1.7	0.5	3	2.7
UAV	0	0	0	1	1	0	2	6	7	1	1.8	2.6	0	-0.7
CADETS	0	0	2	4	0	0	1	2	1	0	1.0	1.3	0	-0.8
NONCF	1	1	2	0	0	1	0	0	0	0	0.5	0.7	0	-0.7
Total	**2**	**3**	**6**	**7**	**3**	**3**	**5**	**8**	**10**	**2**	**5.0**	**2.9**	3	**-0.7**

Table 6 – Aircraft Destroyed / Written-off

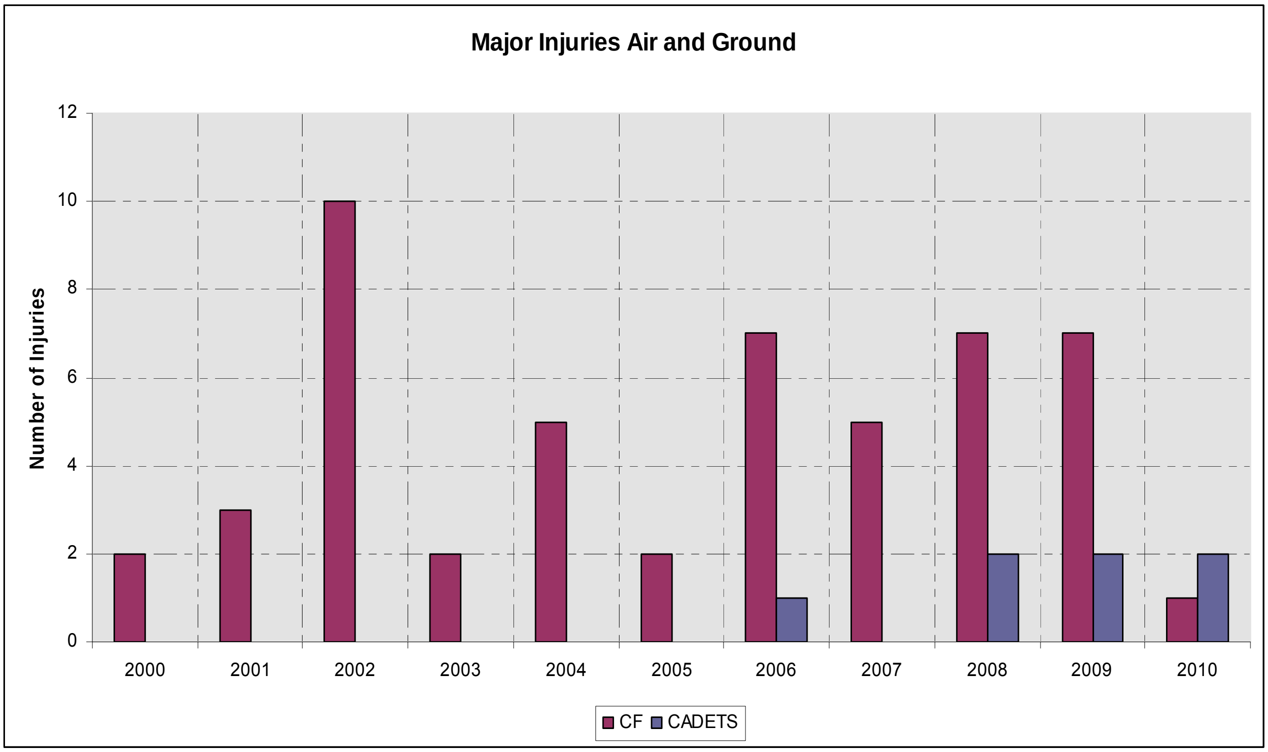
Note: 2010 Heron 255 UAV accident cooperation investigation not included to DFS statistical analysis.

3.2.4 Fatalities and Injuries

3.2.4.1 Major Injuries

There were no very serious injuries or fatalities in 2010. This represents very positive results within the CF and Air Cadet movement. This has not been seen since 2005.

There were 2 serious Cadet injuries due to two separate SZ23 hard landings and one CF serious injury when an FE was pinned between the CH147 ramp and the airframe on landing.



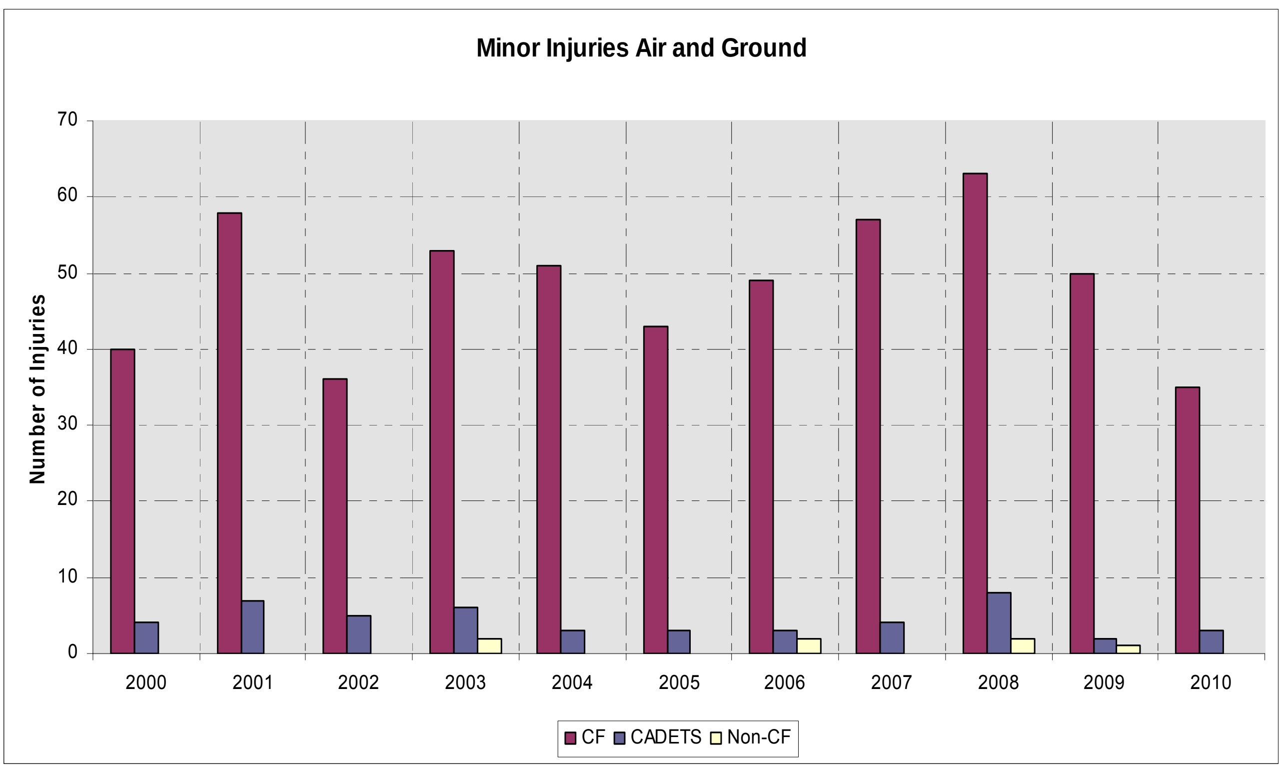
Graph 5 – Major Injuries

Year		00	01	02	03	04	05	06	07	08	09	00-09 Mean	09-08 SD	10	D
CF	Fatal	0	0	2	1	1	0	3	1	2	3	1.3	1.2	0	-1.1
	Very Serious	0	1	1	0	0	0	0	1	2	0	0.5	0.7	0	-0.7
	Serious	2	2	7	1	4	2	4	3	3	4	3.2	1.7	1	-1.3
	Total	**2**	**3**	**10**	**2**	**5**	**2**	**7**	**5**	**7**	**7**	**5.0**	**2.7**	**1**	**-1.5**
CADETS	Very Serious	0	0	0	0	0	0	0	0	1	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	0	0	1	0	1	2	0.4	0.7	2	2.3
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**2**	**2**	**0.5**	**0.8**	**2**	1.8

Table 7 – Major Injuries

3.2.4.2 Minor Injuries

Graph 6 shows a total of 38 minor injuries occurred in 2010, down from 52 in 2009. This is a significant improvement to levels not seen since 2002.



Graph 6 - Minor Injuries

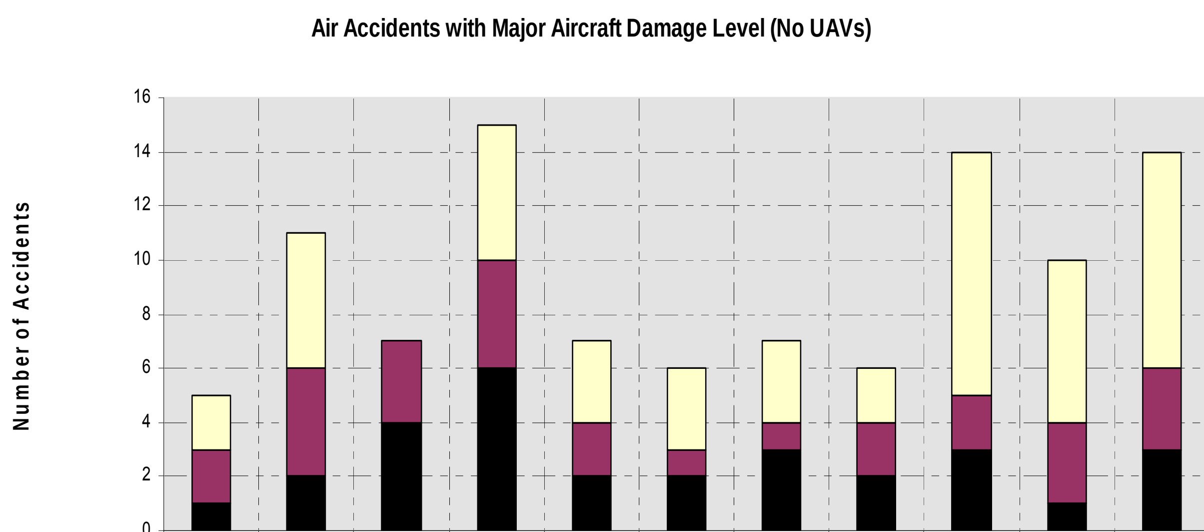
Year	00	01	02	03	04	05	06	07	08	09	Mean	SD	10	D
Cadets	4	7	5	6	3	3	3	4	8	2	4.5	2.0	3	-0.8
CF	40	58	36	53	51	43	49	57	63	50	50.0	8.4	35	-1.8
Non-CF	0	0	0	2	0	0	2	0	2	1	0.7	0.9	0	-0.7
Total	**44**	**65**	**41**	**61**	**54**	**46**	**54**	**61**	**73**	**53**	**55.2**	**10.0**	**38**	**-1.7**

Table 8 - Minor Injuries

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 14 with 3 CF aircraft destroyed. This marks the second high year in the last three (Graph 7). For Air Cadets, the Very Serious ADL is shown in orange (Table 9) and represents a concern. Please note that due to a review of closing action reports for Cadet occurrences, data for all years except 2005/2006 have changed.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Serious	2	5	0	5	3	3	3	2	9	6	8
Very serious	2	4	3	4	2	1	1	2	2	3	3
Destroyed/missing	1	2	4	6	2	2	3	2	3	1	3

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

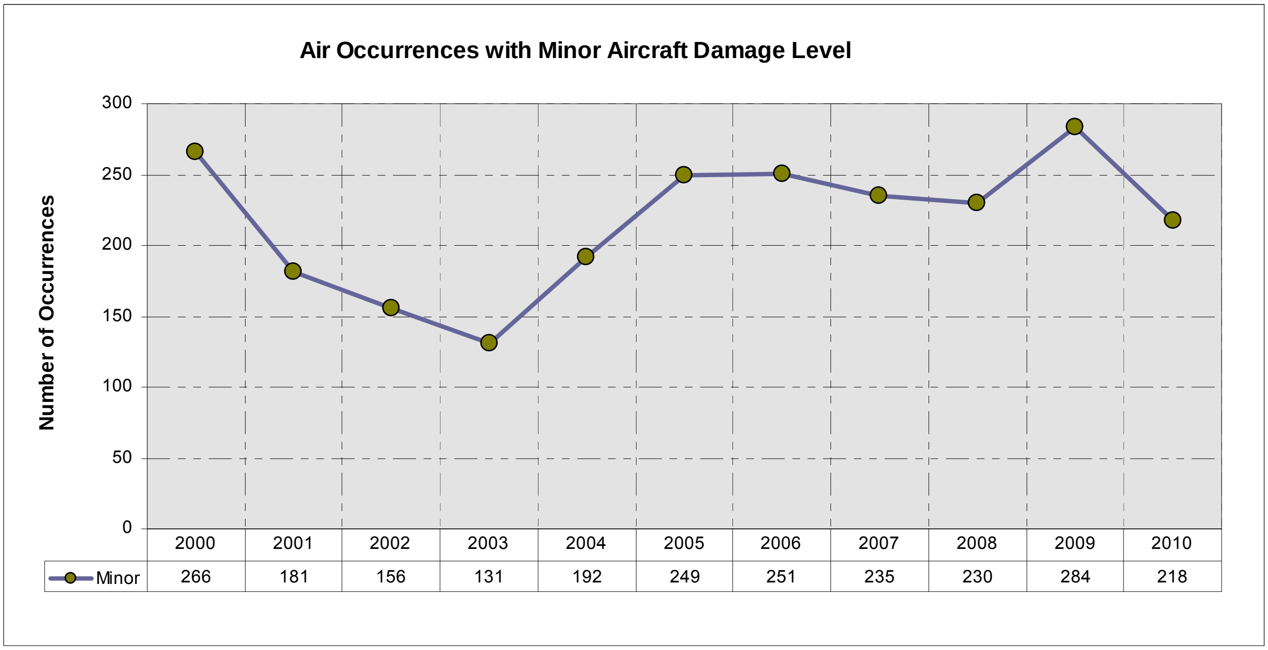
MAJOR ADL BY A/C TYPE		00	01	02	03	04	05	06	07	08	09	00-09 Mean	00-09 SD	10	D
CADETS	Destroyed	0	0	2	4	0	0	1	1	1	0	0.9	1.3	0	-0.7
	Very Serious	2	3	1	1	1	1	1	1	2	2	1.5	0.7	3	2.1
	Serious	1	0	0	3	1	0	0	1	0	2	0.8	1.0	1	0.2
	Total	**3**	**3**	**3**	**8**	**2**	**1**	**2**	**3**	**3**	**4**	**3.2**	**1.9**	**4**	**0.4**
CF	Destroyed	1	2	2	2	2	2	2	1	2	1	1.7	0.5	3	2.7
	Very Serious	0	1	2	3	1	0	0	1	0	1	0.9	1.0	0	-0.9
	Serious	1	5	0	2	2	3	3	1	9	4	3.0	2.6	7	1.5
	Total	**2**	**8**	**4**	**7**	**5**	**5**	**5**	**3**	**11**	**6**	**5.6**	**2.6**	**10**	**1.7**
UAV	Destroyed	0	0	0	1	1	0	2	6	7	1	1.8	2.6	0	-0.7
	Very Serious	0	0	0	1	2	0	5	0	9	0	1.7	3.0	0	-0.6
	Serious	0	0	0	2	1	2	1	1	0	0	0.7	0.8	0	-0.9
	Total	**0**	**0**	**0**	**4**	**4**	**2**	**8**	**7**	**16**	**1**	**4.2**	**5.1**	**0**	**-0.8**
Total		**5**	**11**	**7**	**19**	**11**	**8**	**15**	**13**	**30**	**11**	**13.0**	**7.2**	**14**	**0.1**

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

Note: Due to a review of closing action reports for Cadet occurrences, data for all years except 2005/2006 have changed slightly.

3.2.5.2 Air Occurrences with Minor ADL

In 2010, there was a decrease in occurrences with minor ADL (Graph 8).



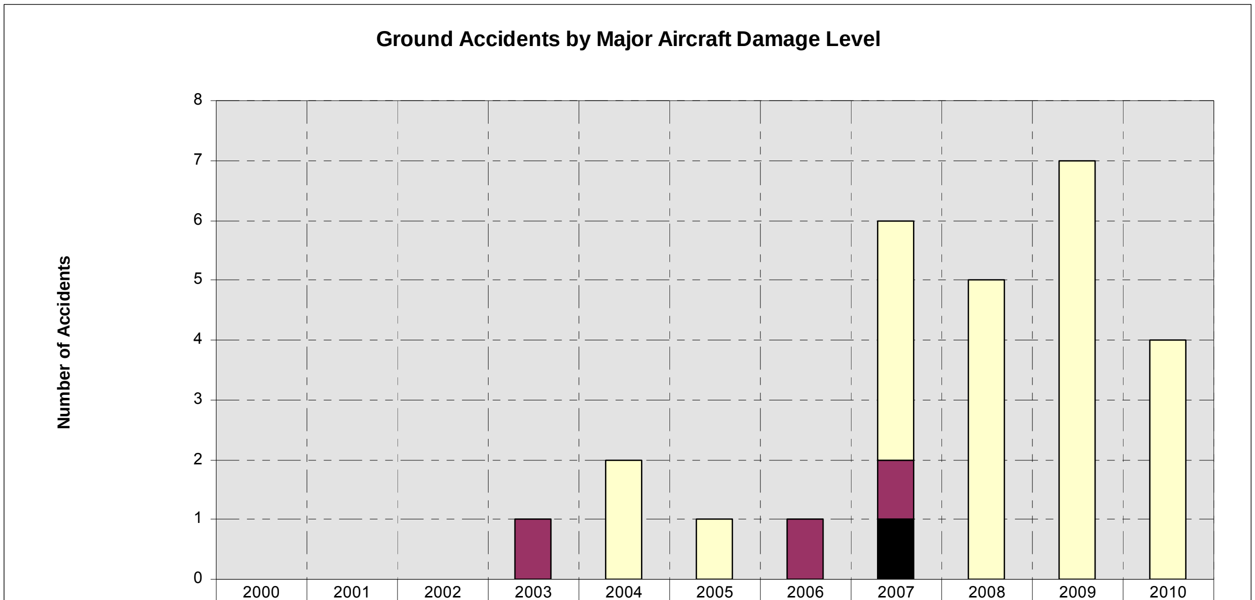
Graph 8 – Air Occurrences with Minor Aircraft Damage Level

AIR OCCURRENCES WITH MINOR ADL	00	01	02	03	04	05	06	07	08	09	00-09 Mean	00-09 SD	10	D
CADETS	12	10	20	11	8	10	19	11	19	17	13.7	4.5	8	-1.3
CF	254	171	136	118	181	236	209	216	203	258	198.2	47.0	208	0.2
UAV	0	0	0	2	3	3	23	8	8	9	5.6	7.0	2	-0.5
Total	**266**	**181**	**156**	**131**	**192**	**249**	**251**	**235**	**230**	**284**	**217.5**	**50.1**	**218**	**0.0**

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 decreased in 2010 from the last three year high. (Graph 9 and Table 11); the 4 serious ground accidents involved a CF188 , a CT114, and two SZ23. All four accidents were preventable.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Serious	0	0	0	0	2	1	0	4	5	7	4
Very serious	0	0	0	1	0	0	1	1	0	0	0
Destroyed/missing	0	0	0	0	0	0	0	1	0	0	0

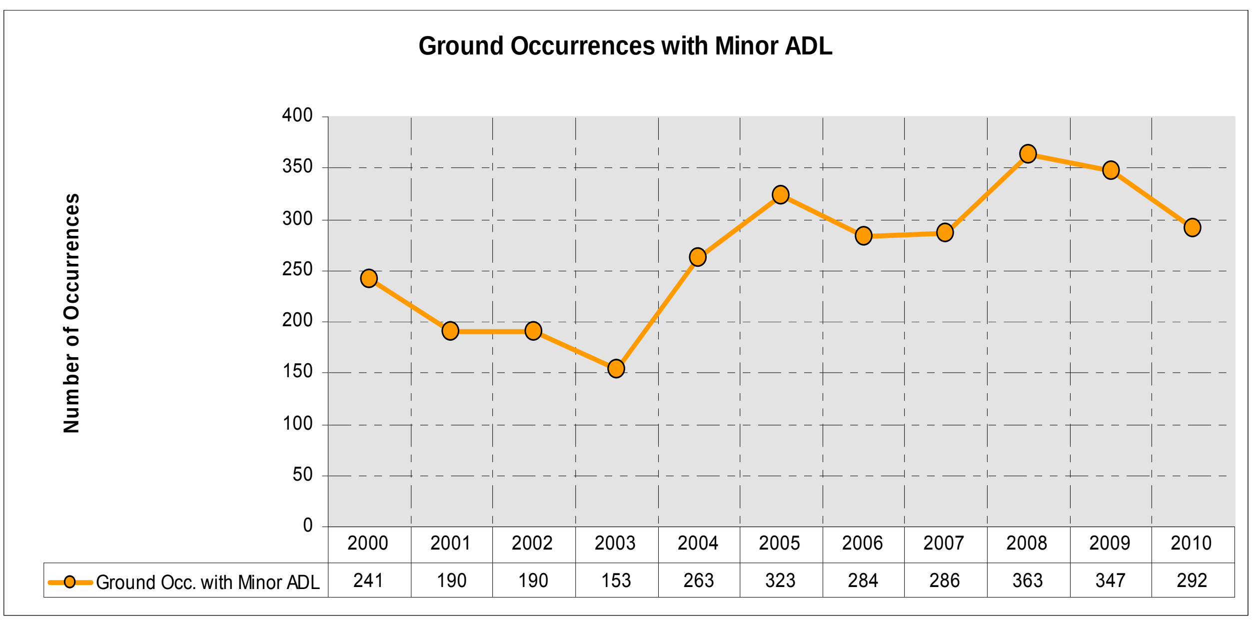
Graph 9 – Ground Accidents by Aircraft Damage Level

GROUND ACCIDENTS WITH MAJOR ADL BY A/C TYPE		00	01	02	03	04	05	06	07	08	09	00-09 Mean	00-09 SD	10	D
CADETS	Destroyed	0	0	0	0	0	0	0	1	0	0	0.1	0.3	0	-0.3
	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	0	0	0	0	2	n/a
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0.2**	**0.4**	**2**	**n/a**
CF	Very Serious	0	0	0	1	0	0	0	0	0	0	0.1	0.3	0	-0.3
	Serious	0	0	0	0	2	1	0	3	5	6	1.8	2.3	2	0.1
	Total	**0**	**0**	**0**	**1**	**2**	**1**	**0**	**3**	**5**	**6**	**1.9**	**2.3**	**2**	**0.1**
UAV	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	0	0	0	0	1	0.1	0.3	0	-0.3
	Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**1**	**0.2**	**0.4**	**0**	**-0.5**
Total		**0**	**0**	**0**	**1**	**2**	**1**	**1**	**5**	**5**	**7**	**2.3**	**2.7**	**4**	**0.6**

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 (Graph 10 and Table 12) decreased from the previous year. Although the number is above the 10-year mean, it is within one standard deviation.



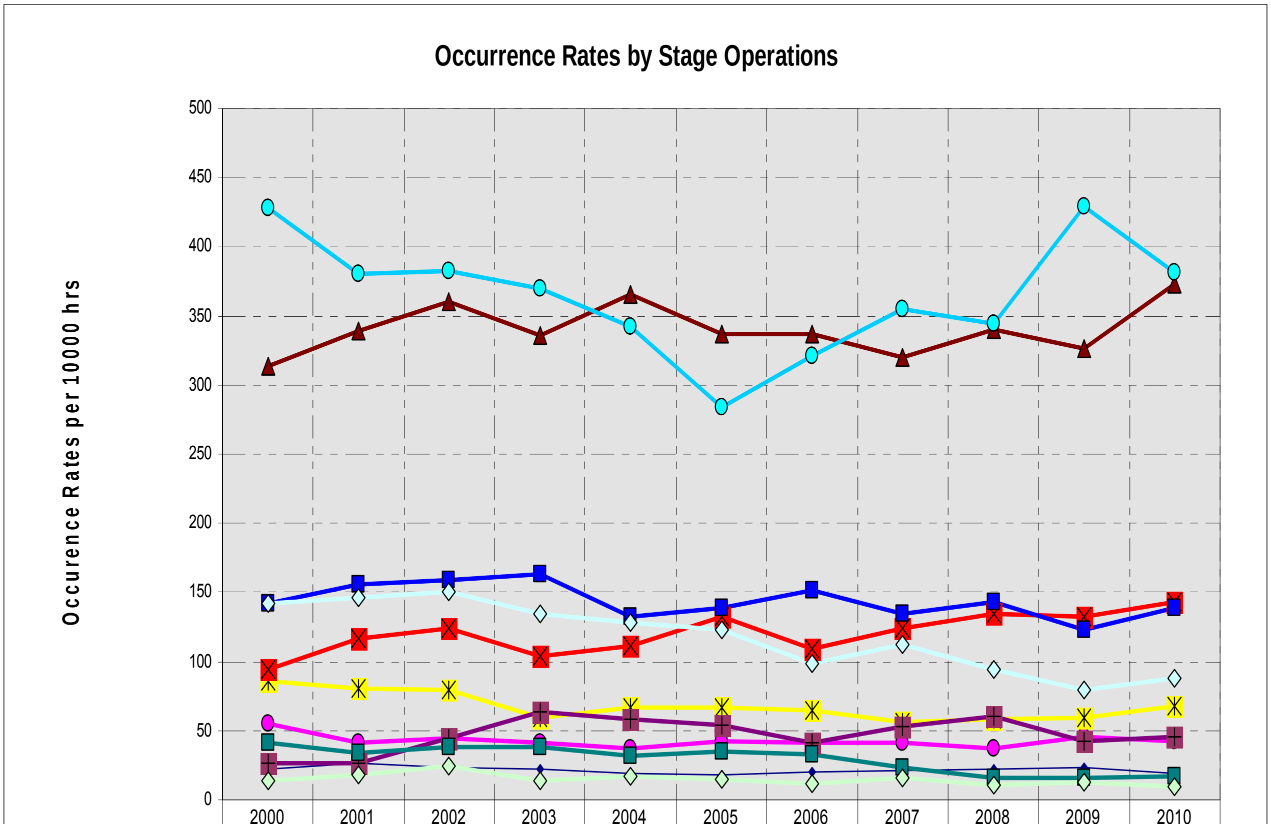
Graph 10 – Ground Occurrences with Minor Aircraft Damage Level

GROUND OCCURRENCE WITH MINOR ADL BY ORGANISATION	00	01	02	03	04	05	06	07	08	09	00-09 Mean	00-09 SD	10	D
CADETS	5	6	14	10	5	13	8	15	22	15	11.3	5.5	10	-0.2
CF	236	184	176	141	257	309	276	269	341	331	252	67.7	282	0.4
UAV	0	0	0	2	1	1	0	2	0	1	0.7	0.8	0	-0.9
Total	**241**	**190**	**190**	**153**	**263**	**323**	**284**	**286**	**363**	**347**	**264**	**70.6**	**292**	**0.4**

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 an increase with D values above the normal variation.(Graph 11) The Maintenance stage (D=2.2) increased significantly and requires examination by maintenance staff. The Parked stage (D=1.8) increased and requires close monitoring.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Towing	21.9	26.4	23.4	22.5	19.3	17.9	19.9	20.7	22.5	23.3	19.1
Taxi	54.8	41.8	44.8	41.6	36.7	42.7	41.2	41.3	37.5	45.5	41.8
Take-Off	85.8	80.1	79.9	59.7	66.3	67.1	65.1	56.1	57.9	59.3	68.0
Parked	93.9	116.2	123.7	104.1	111.1	132.6	109.4	123.5	135.0	132.8	143.4
Not Reported	26.2	26.8	44.3	63.5	57.8	54.1	41.2	52.5	60.4	42.2	45.6
Maintenance	313.6	338.8	360.5	336.3	365.0	336.5	336.9	319.8	340.4	326.4	372.5
Load/Unload/Weap	41.5	33.4	38.5	38.2	32.2	35.4	33.0	22.9	15.8	16.0	17.0
Landing	142.0	156.2	158.8	162.9	132.1	139.1	151.1	134.3	143.3	123.4	138.4
In-Flight	428.4	380.2	381.9	369.7	342.6	284.4	320.6	354.4	344.6	429.4	381.6
Ground Running	142.0	145.7	150.0	134.2	128.5	122.5	98.6	112.7	94.2	79.3	87.8
Go Around	13.3	17.6	23.9	13.4	17.0	15.1	11.8	15.7	10.8	12.4	9.1

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

OCCURRENCE RATES BY STAGE OF OPERATION	09	00-09 Mean	00-09 SD	10	D
Towing	23.3	21.8	2.4	19.1	-1.1
Taxi	45.5	42.8	5.0	41.8	-0.2
Take-Off	59.3	67.7	10.5	68.0	0.0
Parked	132.8	118.2	13.7	143.4	1.8
Not Reported	42.2	46.9	13.1	45.6	-0.1
Maintenance	326.4	337.4	16.0	372.5	2.2
Load/Unload/W. Handling	16.0	30.7	9.2	17.0	-1.5
Landing	123.4	144.3	12.7	138.4	-0.5
In-Flight	429.4	363.6	44.9	381.6	0.4
Ground Running	79.3	120.8	23.9	87.8	-1.4
Go Around	12.4	15.1	3.8	9.1	-1.6
Total	**1290.1**	**1309.4**	**64.6**	**1324.3**	**0.2**

Table 13 - Occurrence Rates by Stage of Operation

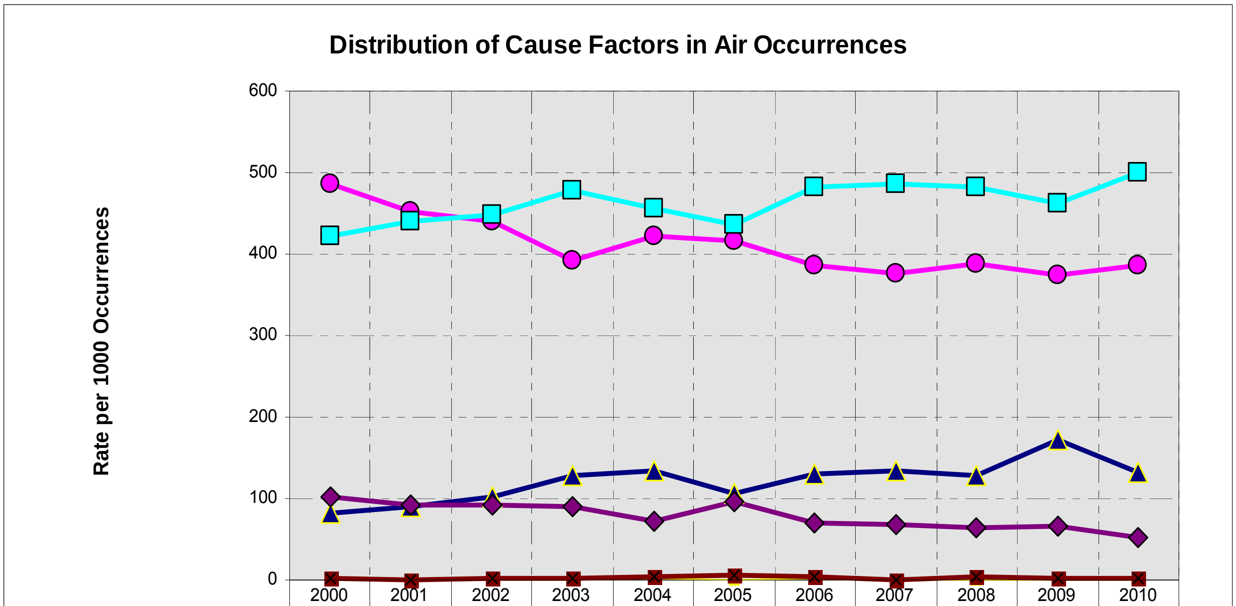
3.3 CAUSE FACTORS

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 reports were omitted due to the fact the reports are incomplete and the data could subsequently change.

3.3.1.1 Air Occurrences

There has been no significant change in the distribution of cause factors in air occurrences as seen in Graph 12. All rates have decreased due to a reduction in occurrence reporting combined to an increase in flying hours.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ENVIRONMENT	82	91	102	127	135	107	129	133	129	172	132
MATERIEL	486	453	441	393	422	415	386	377	387	373	387
OPERATIONAL	1	0	0	0	1	0	1	1	1	1	0
PERSONNEL	422	440	448	478	455	437	483	486	481	462	501
UNDETERMINED	102	93	91	89	72	96	71	68	65	66	52
UNIDENTIFIED FOD	2	1	3	1	3	6	3	1	5	3	2

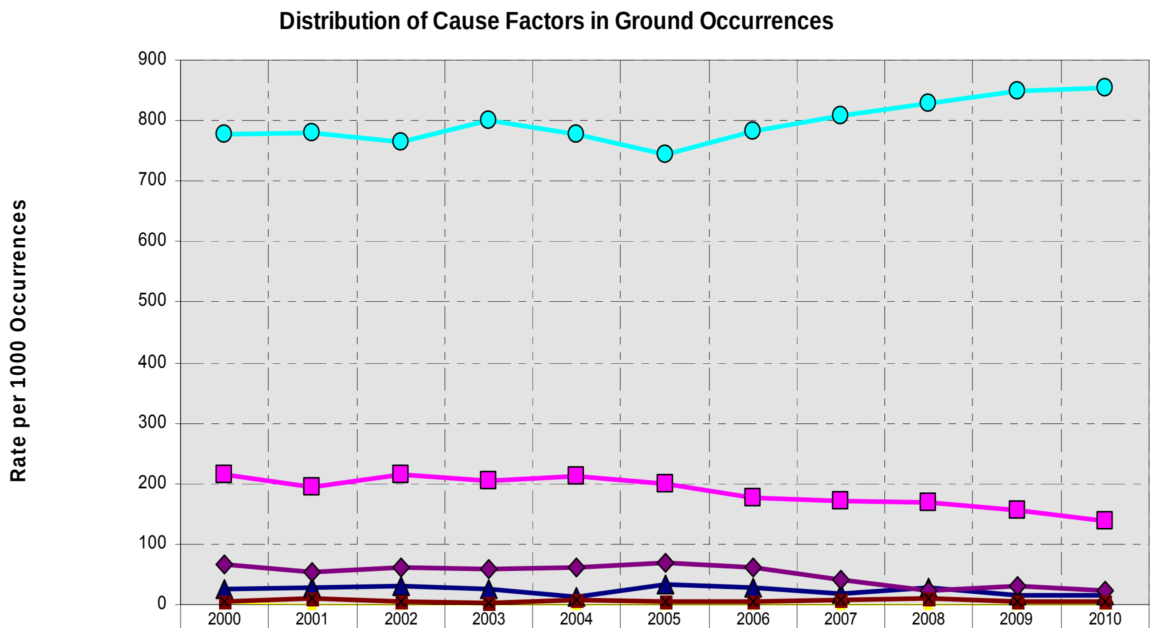
Graph 12 - Distribution of Cause Factors in Air Occurrences

Air Cause Factors by Type	2009	00-09 Mean	00-09 SD	2010	D
Environment	172	120.6	25.9	132	0.4
Materiel	373	413.4	37.3	387	-0.7
Operational	1	0.5	0.5	0	-1.0
Personnel	462	459.1	22.4	501	1.9
Undetermined	66	81.3	14.1	52	-2.1
Unidentified FOD	3	2.6	1.7	2	-0.1
Total	**1076**	**1077.6**	**11.4**	**1073**	**-0.4**

Table 14 - Air Cause Factors by Type

3.3.1.2 Ground Occurrences

This is the second consecutive year we have seen a reduction in the ground occurrence rate although there has been no significant change in the distribution of cause factors as seen in Graph 13.



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
ENVIRONMENT	26	29	30	26	14	32	27	18	27	16	17
MATERIEL	216	194	214	206	212	199	177	172	168	156	139
OPERATIONAL	2	0	0	0	0	0	0	0	0	0	1
PERSONNEL	778	779	763	800	777	745	783	808	829	850	855
UNDETERMINED	67	53	62	59	61	68	61	41	24	29	24
UNIDENTIFIED FOD	5	11	4	3	8	6	5	7	10	5	5

Graph 13 - Distribution of Cause Factors in Ground Occurrences

Ground Cause Factors by Type	2009	00-09 Mean	00-09 SD	2010	D
Environment	16	24.5	6.4	17	-1.2
Materiel	156	191.4	21.5	139	-2.4
Operational	0	0.2	0.6	1	1.0
Personnel	850	791.2	31.1	855	2.1
Undetermined	29	52.6	15.6	24	-1.8
Unidentified FOD	5	6.6	2.7	5	-0.6
Total	**1057**	**1066.5**	**17.0**	**1041**	**-1.5**

Table 15 - Ground Cause Factors by Type

3.3.1.3 Comparison of Cause Factors for Air and Ground Occurrences

Table 15 indicates that there is a marked decrease in the materiel ratio for ground occurrences accompanied by a similar increase in the personnel ration. Graph 13 shows this trend has slowly increased over the last 10 years. The personnel ratio remains above the material ratio.

Table 14 on the other hand indicates a similar decrease in the materiel ratio for air occurrences accompanied by an increase in the personnel ratio. However, the air occurrences personnel have been above and remain above air materiel since 2003.

3.3.2 HFACS Data

3.3.2.1 Evolving Issues

The past year has seen some significant discussions involving HFACS. An in depth DFS statistical study done in 2010 has shown that data for some factors had different trends in the time period 2004-2007 compared to 2007-2010. This different behaviour of HFACS data is mainly due to the change of HFACS assigning methodology in the FSOMS reporting process. A review of all occurrences between 2004 and 2009, with at least one Deviation cause factor, indicated that the assignment of Human Cause factors by FS Officers lacked consistency. DFS is considering measures to enhance quality control such as additional instruction, test cases and occurrence sampling. The FSOMS working group also identified some concerns with the assignment/interpretation of HFACS. The DFS HFACS subject matter expert presented some of these issues at the DFS Annual Seminar and conducted syndicate work with over 60 flight safety personnel present in order to identify community concerns. Issues include: lack of quality control; both overlap and gaps in HFACS cause factor matrix leading to subjective assignment of cause factors, and poor applicability of HFACS results to operations. This has resulted in very poor consistency (internal validity) using HFACS results to improve flight safety. The resulting observations and recommendations are forthcoming.

3.3.2.2 Analysis

Although the HFACS analysis methodology is evolving, low levels of randomness normally imply the systemic presence of the cause factor in the occurrences. One reason for these patterns is the increasing/decreasing trends of monthly occurrences. Another reason could be the change of reporting methodology. In light of the observation detailed in 3.3.2.1, submission of conclusion concerning HFACS analysis will be withheld until the DFS review is complete. However, there was one specific area of concern where we experienced a significant increase in perception errors/ground combined to a very low level of randomness. This is indicative of a trend and will be verified by the appropriate organisation.

CAUSE FACTORS		TYPE	CAUSE FACTORS vs REPORTS FILED			
			Mean 04-09	2009	2010	RL 04-10
ACTIVE FAILURES						
ERRORS	Decision Error	Air	80.4	81.3	80.8	High
		Ground	83.2	81.3	75.1	High
	Perception Error	Air	24.4	49.5	38.8	Very Low

CAUSE FACTORS		TYPE	CAUSE FACTORS vs REPORTS FILED			
			Mean 04-09	2009	2010	RL 04-10
		Ground	17.0	39.6	40.7	VERY LOW
	Skilled Based Error	Air	210.3	193.8	173.7	Very Low
		Ground	213.9	220.7	202.3	Very Low
DEVIATIONS	Routine Deviation	Air	3.8	4.9	2.5	High
		Ground	8.8	11.0	8.6	High
	Exceptional Deviation	Air	11.3	9.0	4.5	Medium
		Ground	28.8	18.2	13.4	High
LATENT CONDITIONS						
CONDITIONS OF PERSONNEL	Mental State	Air	160.6	179.1	153.0	Very Low
		Ground	154.1	201.0	170.5	Very Low
	Physical / Mental Capabilities	Air	27.8	31.5	26.7	Very Low
		Ground	23.7	24.6	20.7	Very Low
	Physiological States	Air	2.9	2.6	2.2	n/a
		Ground	1.6	0.9	0	n/a
WORKING CONDITIONS	Technological Environment	Air	12.1	15	12.4	Low
		Ground	13.8	11.9	12.4	Low
	Physical Environment	Air	17.7	24.9	17.2	Very Low
		Ground	18.3	28.3	24.8	Very Low
PRACTICES OF PERSONNEL	Resource Management	Air	38.4	49.5	50.9	High
		Ground	34.4	43.1	42.0	Low
	Personal Readiness	Air	0.9	1.2	1.0	n/a
		Ground	0.5	1.2	1.3	n/a
SUPERVISION	Planned Activities	Air	8.2	11.9	9.5	High
		Ground	14.2	14.8	10.8	Medium
	Problem Correction	Air	5.0	6.1	4.5	High
		Ground	9.7	12.7	5.7	Medium

CAUSE FACTORS		TYPE	CAUSE FACTORS vs REPORTS FILED			
			Mean 04-09	2009	2010	RL 04-10
	Supervisory Deviation	Air	1.1	2.9	0.6	n/a
		Ground	3.9	4.9	4.1	High
	Level of Supervision	Air	29.6	28.3	29.6	Very Low
		Ground	54.8	66.5	53.8	High
ORG INFLUENCES	Organizational Climate	Air	5.6	7.8	4.5	Medium
		Ground	9.5	11.9	11.1	Very Low
	Organizational Process	Air	14.9	9.8	8.6	High
		Ground	25.0	17.9	16.9	Low
	Resource Management	Air	7.8	9.0	5.4	High
		Ground	13.5	11.3	12.7	Low

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

Note: The table is (#Occurrences per Factor/ #Reports Filed) * 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 analysed in relation to the RL to determine the relative validity of the information. A low RL value suggests a systematic pattern and is a good indication of a trend. Where Table 17 indicates an area of concern (Orange or Maroon), further information is provided in follow-on sub-paragraphs. As applicable, key inputs submitted by DFS to the Airworthiness Review Board are provided.

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 00-09	09	10	RL 00-10
ALL A/C	**N/A**	**169.3**	**168.2**	**157.0**	**Low**
CC115 Buffalo	**Overall**	**298.4**	**487.1**	**291.4**	**Very low**
	Weapons systems	48.7	124.9	41.6	Very Low
	Flight Instruments	7.8	31.2	29.7	n/a
	Undercarriage (landing gear)	29.8	37.5	29.7	Low
CC130	**Overall**	**237.0**	**270.7**	**315.2**	**Very Low**
	Weapons Systems	15.6	37.2	52.5	Very low

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 00-09	09	10	RL 00-10
Hercules	Propeller/Engine Controls /Instruments	20.1	28.6	37.8	High
	Propeller	17.0	25.1	28.4	Low
CC138 Twin Otter	**Overall**	**78.4**	**92.9**	**140.2**	**High**
	Fuselage/Wings/Empennage	5.9	10.9	16.8	n/a
	Jet/Turbo Basic Engine	4.3	0.0	16.8	n/a
	Survival & Safety Equipment	2.4	0.0	16.8	n/a
CC144 Challenger	**Overall**	**32.7**	**19.4**	**24.9**	**High**
	Panels/Doors/Transparent Areas	5.9	3.2	10.7	n/a
	Controls (Other)	0.7	3.2	3.6	n/a
	Hydraulics	0.7	0.0	3.6	n/a
CC150 Polaris (Airbus 310)	**Overall**	**43.1**	**9.2**	**30.3**	**Very Low**
	Panels/Doors/Transparent Areas	7.9	0.0	7.0	Low
	Fuel Systems	2.3	2.3	4.7	n/a
	Hydraulics	1.9	0.0	4.7	n/a
CC177 Globemaster III	**Overall**	**39.6**	**28.1**	**55.2**	**n/a**
	Fuselage/Wings/Empennage	0.9	2.8	10.5	n/a
	Panels/Doors/Transparent Areas	9.3	8.4	10.5	n/a
	Flight Instruments	1.3	0.0	5.3	n/a
CF188 Hornet	**Overall**	**354.1**	**409.1**	**322.8**	**High**
	Weapons Systems	63.6	88.6	69.6	High
	Survival & Safety Equipment	29.6	41.6	45.9	High
	Undercarriage (Landing Gear)	44.9	49.3	38.5	Medium
CH124 Sea King	**Overall**	**187.9**	**154.5**	**165.4**	**Medium**
	Other	10.3	3.8	25.3	High
	Hydraulics	8.1	10.2	14.7	Medium
	Weapons Systems	12.8	19.2	14.7	Low
CH139 Jet Ranger Bell 206B	**Overall**	**39.2**	**177.2**	**207.2**	**Very Low**
	Helicopter Flight Controls	11.5	91.3	60.0	n/a
	Helo Main Rotor Head / Rotor Drive Train	2.8	16.1	38.2	n/a
	Gearboxes/Accessories/ Drives	1.9	10.7	27.3	n/a
CH146 Griffon	**Overall**	**136.6**	**103.3**	**130.0**	**High**
	Helicopter Flight Controls	21.9	18.2	21.0	Medium
	Helo Main Rotor Head / Rotor Drive Train	10.0	8.4	17.7	Medium

A/C TYPE	AIRCRAFT SYSTEMS	RATE			
		Mean 00-09	09	10	RL 00-10
	Panels / Doors / Transparent Areas	10.7	13.8	12.7	Medium
CH149 Cormorant	**Overall**	**220.9**	**260.5**	**261.0**	**Very low**
	Furnishings and Loose Equipment	34.8	59.5	61.6	Medium
	Other	13.2	16.4	29.5	Low
	Panels / Doors / Transparent Areas	16.7	12.3	27.1	Very Low
CP140 Aurora	**Overall**	**238.6**	**231.0**	**269.6**	**High**
	Electrical Systems	24.7	31.9	29.2	High
	Survival & Safety Equipment	11.0	16.9	27.3	Low
	Undercarriage (Landing Gear)	16.6	20.7	27.3	High
CT102 Astra	**Overall**	**62.1**	**101.4**	**92.2**	**Low**
	Fuselage / Wings / Empennage	9.2	12.0	14.2	n/a
	Ignition Systems	1.8	5.2	12.8	n/a
	Other	4.4	15.5	12.8	n/a
CT114 Tutor	**Overall**	**134.5**	**137.1**	**187.7**	**Low**
	Survival & Safety Equipment	14.0	15.5	35.9	High
	Undercarriage (Landing Gear)	17.1	10.3	33.1	Low
	Flight Instruments	2.1	2.6	19.3	n/a
CT142 Dash-8	**Overall**	**49.8**	**57.7**	**51.3**	**Very Low**
	Fuel Systems	2.5	6.9	9.3	n/a
	Undercarriage (Landing Gear)	6.1	11.5	9.3	n/a
	Fuselage / Wings / Empennage	3.5	2.3	7.0	n/a
CT145 King Air	**Overall**	**34.2**	**75.9**	**44.0**	**High**
	Undercarriage (Landing Gear)	7.9	14.6	20.5	High
	Propeller/Engine Controls /Instruments	1.9	2.9	14.7	n/a
	Anti-Icing / De-icing Systems	0.3	0.0	2.9	n/a
CT155 Hawk	**Overall**	**172.2**	**145.6**	**106.5**	**High**
	Undercarriage (Landing Gear)	35.6	41.1	24.1	High
	Fuselage / Wings / Empennage	34.5	17.1	17.0	High
	Survival & Safety Equipment	16.8	15.4	11.4	High
CT156 Harvard II	**Overall**	**131.1**	**84.7**	**57.9**	**Medium**
	Undercarriage (Landing Gear)	43.2	30.1	18.7	High
	Survival & Safety Equipment	16.4	8.2	6.2	High
	Flaps	8.5	6.1	4.4	High

Table 17 - System Descriptor rates by Fleet

Note: The colour code is based on the D value

3.3.3.1 Fleet Concerns

- CC115. There are no specific flight safety concerns at this time.
- CC130. The CC130 Hercules is an aging fleet with 15 Open/Active RARMs. Propeller Low Oil Light indications will continue to be a concern with the legacy CC130 fleet until a proper redesign of the system can be implemented.
- CC138. There were 7 occurrence reports categorized as documentation related with an additional 4 occurrences where documentation was mentioned. (11 of 25). This is a significant concern. 15 of 25 occurrences only listed Brief personnel as preventive measures. The low number of occurrences makes it difficult to determine if there is a trend, but these issues should be monitored.
- CC144. Although there are no specific flight safety concerns at this time, the lack of reported ground occurrences is unusual when compared to other CF fleets.
- CC150. Although there are no specific systems of concern, there have been 5 occurrences involving the pushback phase and tow bar release without aircrew prior knowledge. The aircraft rolled back several feet.
- CC177. Trending information is very limited due to the limited time since introduction to service.
- CF188. There were 58 survival & safety systems occurrences including depleted Oxygen bottles and missing restraint straps. Although this is similar to last year, this system descriptor is traditionally very random, and does not represent a trend.
- CH124. Although there were no specific system concerns, there has been a significant increase in the records related occurrences (12 to 21) compared to the previous year. The air traffic/airspace related issues increased from 2 to 8 over the same period.
- CH139. Although the trending data seems to indicates a significant concern, occurrences are similar to last year except for a small increase in hotstarts compared to a reduction in overtorques. These are typical of a training environment and are considered unrelated.
- CH146. There were 34 occurrences involving Helo Main Rotor Head /Rotor Drive Train System. These were quite random and distributed over several issues including incorrectly installed/ missing parts or exceedences. This isn't considered indicative of a significant trend.
- CH149. The new Flight Safety concerns for this period are communication system issues (ICS), cockpit or cabin fumes, hoist stoppages, tail rotor half hub cracking and limit cycle oscillations. There are additional concerns with the reactions to False fire indications and an uncommanded shutdown of No.3 engine still under investigation.
- CP140. The increase in the Survival & Safety Equipment Systems occurrences consisted of unrelated occurrences. A review of the Undercarriage (Landing Gear) occurrences did

identify a series of hot brakes occurrences that were unexplained. Although the same number of event occurred in 2009, the PMs have done little to identify or alleviate recurrence of these events.

- CT102. There are no specific flight safety concerns at this time.

- CT114. There was a small increase in the flight instruments descriptor from the previous year. Although minimal, it did highlight an area of concern. The 2009 occurrence 139410 concerning a failure of the pitot static anti-icing system listed the following PM "Recommend normal fault monitoring for trend development". There were two similar occurrences in 2010 (143094 and 143095). The PM for these occurrences stated that "The trend during the summer airshow season is to not completely verify this system is operating given its minimal use during airshow performances". This is indicative of human factors rather than equipment failure.

- CT142. There are no specific safety concerns at this time.

- CT145. Although there was a slight increase in the Undercarriage (Landing Gear) descriptor this isn't indicative of a trend.

- CT155. Although Bird strikes/ near birdstrikes continue to be one of the primary safety concerns for this fleet at 23 occurrences. There were 25 FOD related occurrences, 16 exceedences (overspeed, overstress) occurrences and 15 icing occurrences.

- CT156. There are no flight safety concerns at this time.

- CH147. There were 70 occurrences for the fleet. Flight safety concerns identified in the AAR were hydraulic leak or failure. Two in 2009, 4 in 2010 and 6 in 2011 to date. Of similar if not more significant interest were the 13 occurrences where aircraft were damaged by vehicles, equipment or cargo.

- CT146.There are no flight safety concerns at this time.

- CC130J. Although the aircraft is operating as advertised, the operational tempo is placing significant stress on both aircrew and technicians.

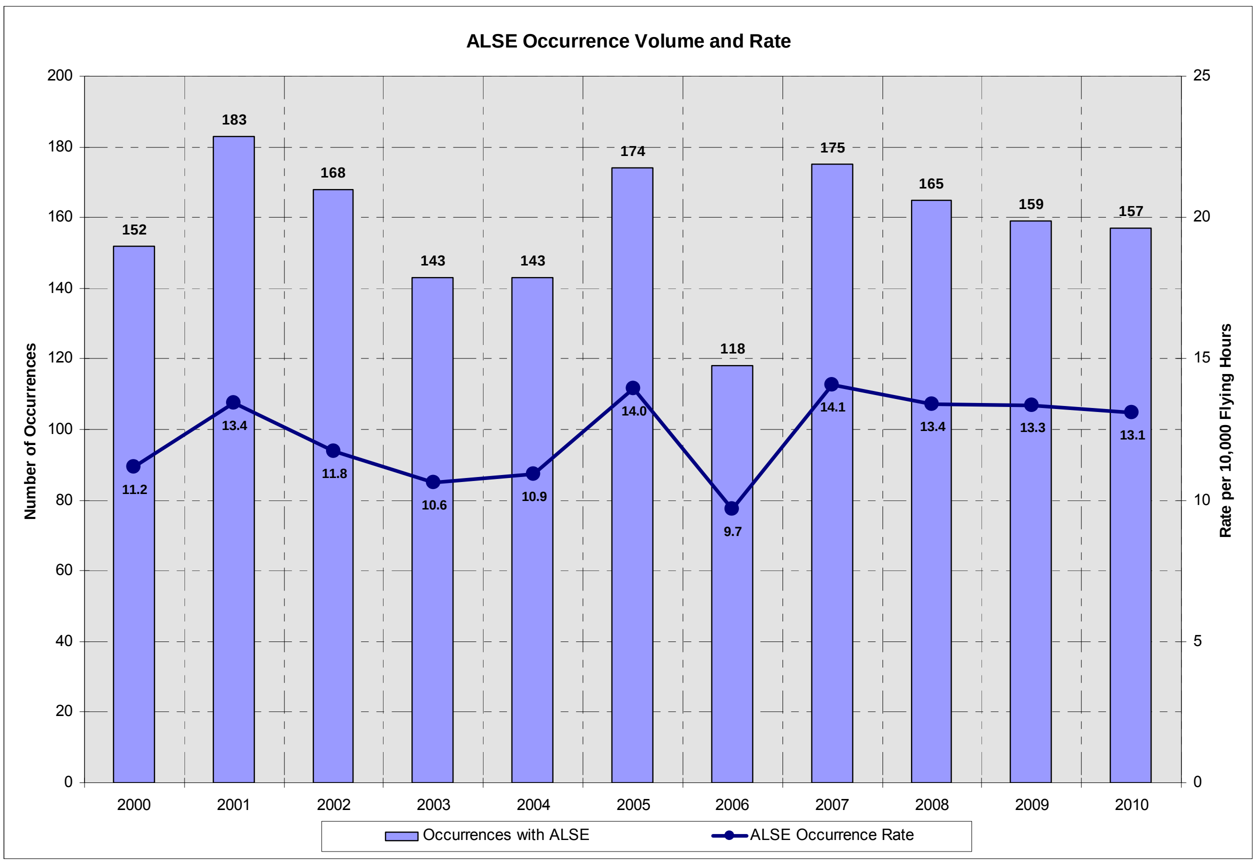
- CU170. This aircraft is not listed in Table 18 as there isn't sufficient data for statistical analysis. The most recent Heron 255 accident in Suffield, AB indicates that there may have been a problem with the navigation systems on board the air vehicle (AV). Two PMs were adopted to prevent the AV from descending below a safe altitude on approach.

- SZ23. Considering the magnitude of launches and recoveries involved in glider operations, the number of occurrences remains low and consistent. Access to movement data would enhance trending. There remains one open PM, amend the Air Cadet Flying Program Manual and incorporates direction for launch abort.

- Air Cadet Glider Program Tow Planes. There are two open PMs proposing changes to the training syllabus be evaluated to increase exposure to crosswinds. ACGP SET is awaiting regions input and result of Apr 11 discussion.

3.3.4 Aircrew Life Support Equipment (ALSE).

The number of occurrences related to survival and safety equipment in 2010 is almost identical to 2009 with 167 occurrences. The rate reduced to 13.1 which is not significantly higher than the ten year mean of 12.2 (Graph 14). A highly proactive effort is being made to address ALSE related issues. While most fleets have seen marked improvements over the past few years, some fleets such as CT155 Hawk are still have significant unresolved ALSE issues. The latter issues are being addressed aggressively.



Graph 14 - ALSE Occurrence Volume and Rate

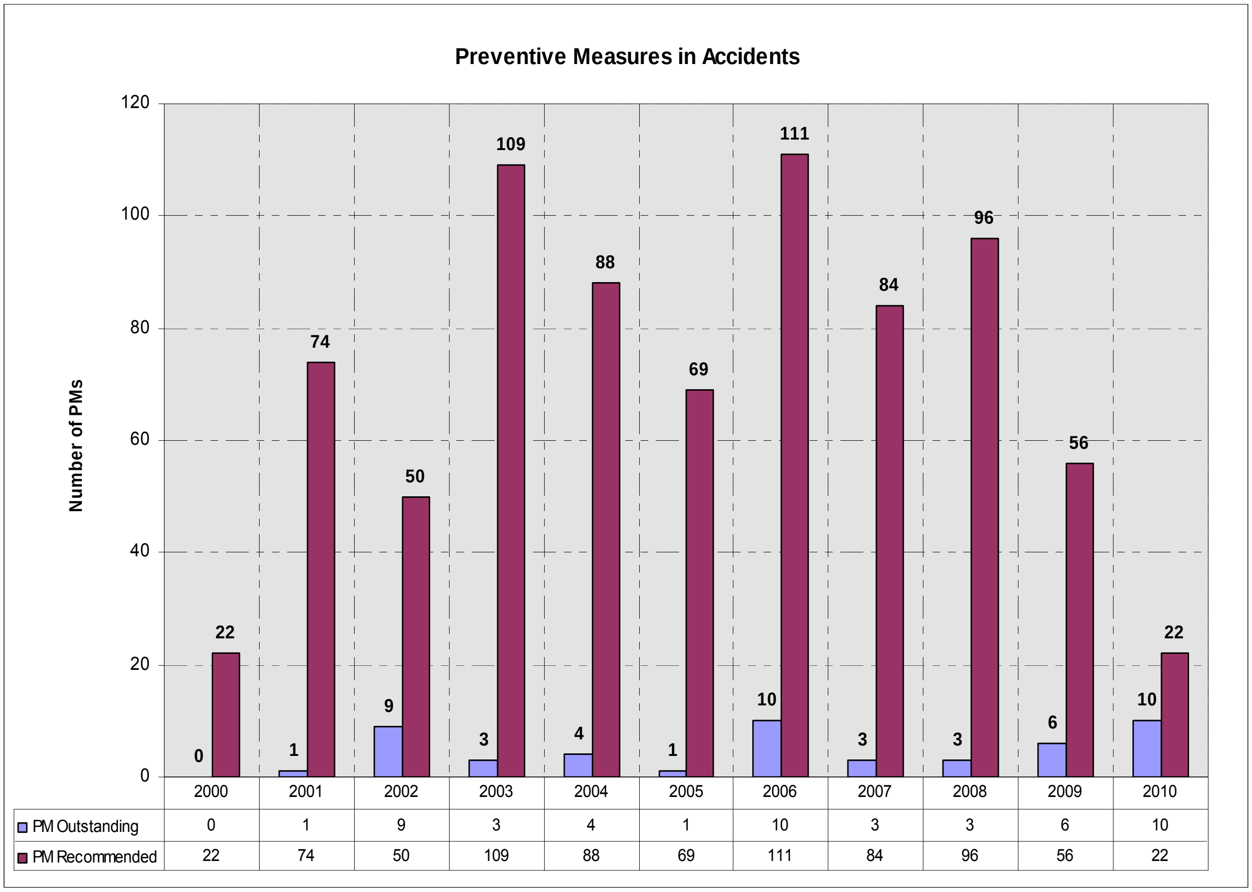
	09	00-09 Mean	00-09 SD	10	D
ALSE RATES	13,3	12.2	1.6	13.1	0.5

Table 18 - ALSE Occurrence Rates

3.3.5 Preventive Measures

3.3.5.1 Open PM from Class 1 Investigations

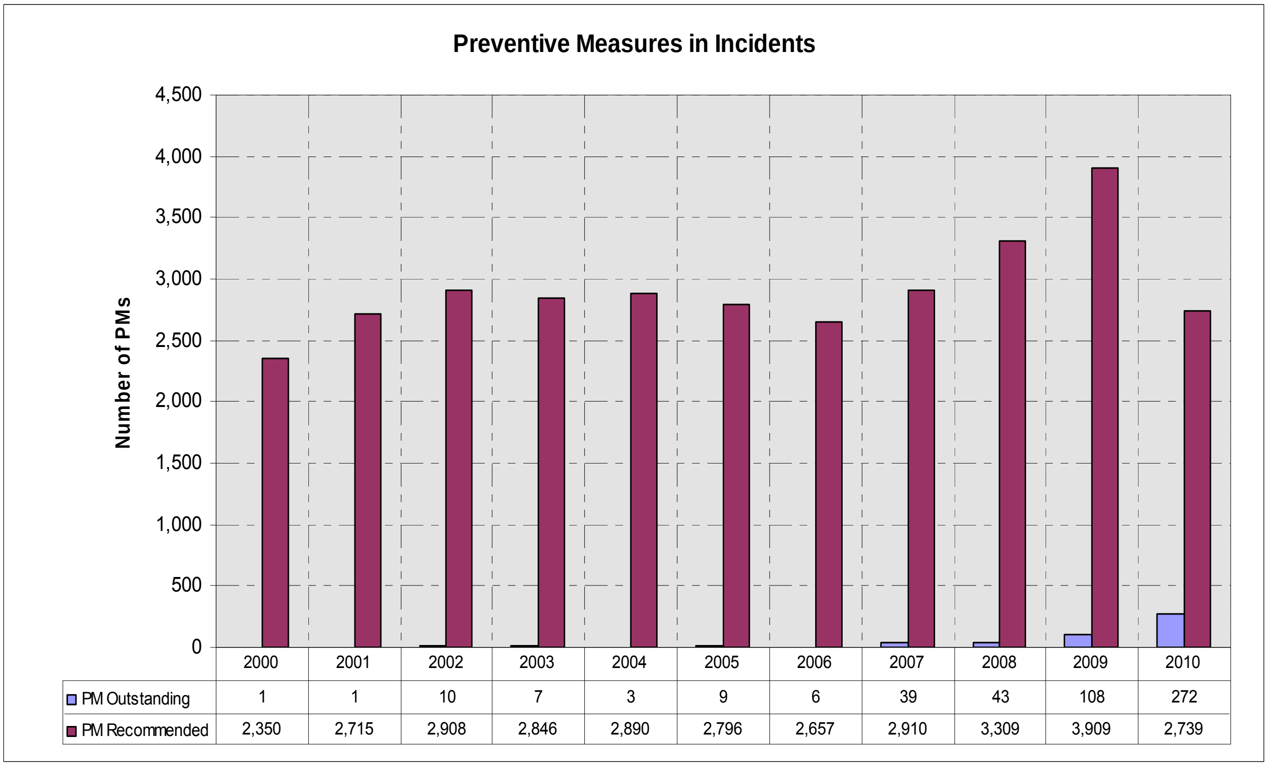
The development of effective Preventive Measures (PM) through FS investigations and their timely staffing/implementation by the chain of command is critical to an effective prevention program. As a result of efforts made in the last few years to improve the staffing of PM in terms of time to implement and record management of measures taken or decisions made, the number of PM recommended that were outstanding has been reduced from the 43 still outstanding in 2006 or earlier for last years report to 31 still outstanding for a comparable time period (Graph 15). It is believed that the PM tracking process is helping the CoC process the proposed measures and hopefully prevent recurrence.



Graph 15 - Outstanding and Recommended Preventive Measures from Class 1 Investigations

3.3.5.2 PM from Class 2 to 4 Investigations

Graph 16 provides the breakdown of PM for all classes of investigation except Class 1. Note that as of 31 Dec 10, some investigations were not completed and further PMs may be proposed as a result of investigation activities. The majority of PM for incidents are staffed and closed at unit level, and are thus closed relatively quickly in comparison to Class 1 PM. Still, some 76 Class 2 to Class 4 PM remain outstanding from 2007 and earlier, this value is comparable to last years report.



Graph 16 - Outstanding and Recommended Preventive Measures from Class 2 to 4 Investigations

4. STATISTICAL METHODOLOGIES

4.1 COEFFICIENT OF DEVIATION VALUE (D)

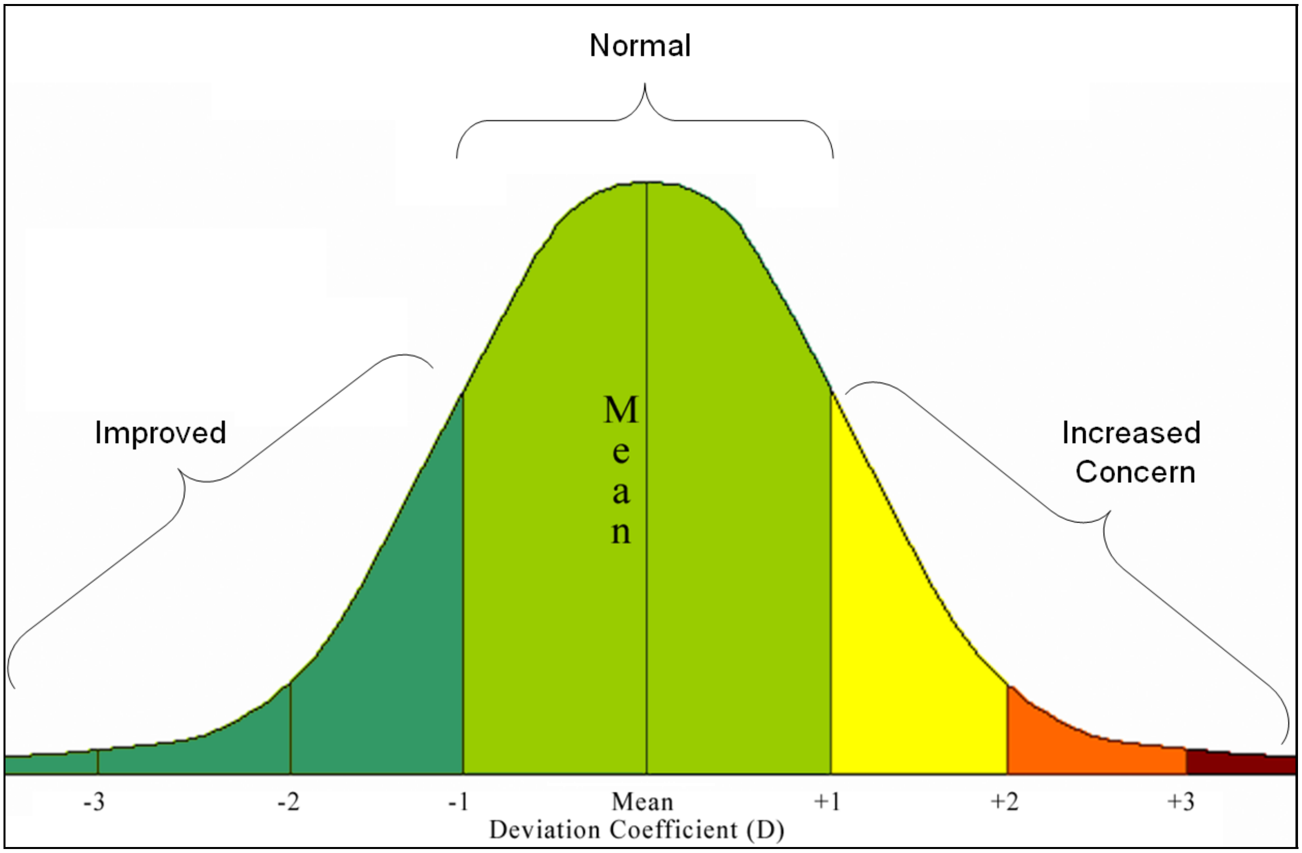
Data values are typically distributed on either side of the mean value. The DFS Statistician measured how far the values are from mean in order to provide an indication of how standard (within a usual range), or alternatively how abnormal (outside of usual range) the value may be, expressed as D. D is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

D = (Value 2010 - Mean [2000-2009]) / Standard Deviation (SD)

If the current year D value is between (-1<D≤1) 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 colored 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≤3), it is colour-coded orange (Caution), and requires examination. If D is between 1 and 2 (1<D≤2), 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 FS Occurrence Management System (FSOMS) as of 31 Dec 10 with Flying Hours provided to DFS by DGAEPM

4.3 RATE CALCULATIONS

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

4.4 RANDOMNESS LEVEL (RL)

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

5. DEFINITIONS

5.1 AIRCRAFT FAMILIES AND CLASSIFICATION CODE

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

FAMILY	CODE	DESCRIPTION
Fighters	CF116	CF5 Freedom Fighter (removed from service in 2003)
	CF188	CF18 Hornet
Helicopters	CH113	Iroquois (removed from service in 2004)
	CH124	Sea King
	CH139	Jet Ranger Bell 206B
	CH146	Griffon
	CH147	Chinook
	CH149	Cormorant
Patrol	CP140	Aurora
Trainers	CT102	Astra
	CT111	Slingsby
	CT114	Tutor
	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
UAV	CU161	Sperwer

FAMILY	CODE	DESCRIPTION
	CU170	Heron

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.
- Nil: The aircraft, including the power plant, has not been damaged.

5.2.2 Personnel Casualty Level (PCL)

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

- Black: PCL level assigned when a fatality has occurred.
- Grey: PCL level assigned when personnel are missing.
- Red: PCL level assigned when personnel are very seriously injured or ill and the person's life is in immediate danger.

- Yellow: PCL level assigned when personnel are seriously injured or ill. There is cause for immediate concern but the patient's life is not in immediate danger. Usually the person is non-ambulatory.

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

5.2.3 Occurrence

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

5.2.3.1 Air Occurrence

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

5.2.3.2 Ground Occurrence

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

5.2.4 Occurrence Category

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

- 'A': Destroyed/missing ADL or Black or Grey PCL.

- 'B': Very serious ADL or Red PCL.

- 'C': Serious ADL or Yellow PCL.

- 'D': Minor ADL or Green PCL.

- 'E': Nil ADL and no injury.

5.2.5 Accident

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

5.2.6 Incident

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

5.2.7 Supplementary Report (SR)

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

5.2.8 Enhanced SR (ESR)

The ESR is to be used for occurrences that are 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.

5.2.9 FS Investigation Report (FSIR)

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

5.2.10 Rate of Occurrences

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

5.2.11 Cause Factors

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

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

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

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

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

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

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

5.2.12 Human Factors Analysis and Classification System (HFACS)

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

5.2.13 Preventive Measures

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