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DFS 2005 Annual Report on Flight Safety

Directorate of Flight Safety

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DIRECTOR COMMENTS

The Canadian Forces (CF) Flight Safety (FS) Program has been in existence since 1942. However, the program as it is known today was really established in the 1960s and 1970s. Over this period of time, the FS system has collected a tremendous amount of data and currently has over 125,000 occurrences registered in the Flight Safety Occurrence Management System (FSOMS) database with 3,000 new occurrences being added each year. While the FS Program has been very good at collecting data, we have not been very good at turning this data into useful information. This is obviously a major shortcoming that needs to be addressed.

In an effort to rectify this problem, the Directorate of Flight Safety (DFS) established a small Trend and Analysis (T&A) Cell in 2004. The initial task was to scope the problem and try and to determine how best to attack this issue. It was obvious that manpower constraints would require some form of automated tools to identify the trends. Therefore, a great deal of time was spent determining which software tools to procure and then training personnel in the use of these tools. This initial step has been completed and this annual report is one of the manifestations of the investment in the T&A Cell.

The intent of this report is to provide a brief analysis of the FS information collected during 2005 to the chain of command and to FS staffs at all levels.

This is the first FS Annual Report that has been produced by DFS. There are no doubt areas that can be improved upon and feedback on this document is therefore solicited and would be greatly appreciated. Comments should therefore be forwarded to either Mister Jacques Michaud, DFS 3 at 613-992-0154 or Captain Loys Vallée, DFS 3-4 at 613- 995-3480.

<original signed by>
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Director of Flight Safety

EXECUTIVE SUMMARY

In a recent review of the Canadian Forces Flight Safety Program, the point was made that flight safety feedback to the chain of command was sporadic and ineffective despite the fact that the flight safety system has been collecting data on aircraft ground and air occurrences for several decades. A major problem was that only rudimentary attempts have been made to trend this information and to analyse these trends. In order to resolve this problem, a small Trending and Analysis Cell was established at Directorate of Flight Safety in 2004 and powerful software tools were procured to assist in identifying trends from the flight safety data. It was also determined that these tools would be used to develop quarterly and Annual Reports on Flight Safety.

This is the first Flight Safety Annual Report. The intent of this report is to provide feedback to the chain of command on the flight safety information that has been gathered during calendar year 2005.

It is assessed that the Flight Safety Program itself is in good shape. Despite the fact that flying rates have decreased over the past ten years, the number of incidents being reported has remained above the ten-year annual average. This is indicative of a healthy reporting culture. In addition Preventive Measures from DFS Flight Safety investigations are being addressed promptly. Having said that, the recommended Preventive Measures from many Supplementary Reports have not yet been staffed although a concerted effort is being made to address this problem. In addition, a systemic issue concerning the manner in which Preventive Measures are tracked once they were identified to the chain of command has been identified and rectification measures have been developed.

Despite the fact that the Flight Safety Program is in good shape, flight safety staffs have been kept busy. The Airworthiness Investigative Authority participated in two joint investigation with the Transportation Safety Board and initiated eighteen investigations; ten accidents (two category ‘A’ damage, one ‘B’, five ‘C’ and two serious injuries), eight incidents (seven ‘D’ and one ‘E’). Approximately 3000 other occurrences were reported and, where appropriate, investigated. DFS completed 18 reports (11 Flight Safety Investigation Reports and seven Enhanced Supplementary Reports). There were no fatalities. Although not considered as accidents, 42 personnel suffered minor injuries. The air accident rate per 10,000 flying hours for 2005 was 0.81, the ground accident rate was 0.16 for a combined accident rate of 0.97. This was one of the highest rates over the last 10 years (the ten-year averages for those rates are respectively 0.45, 0.09 and 0.64). However, four of the accidents in 2005 involved CH146 Griffon helicopter engine problems whereby the engines had to be sent to a third line facility for maintenance work in accordance with the current maintenance contract. Current flight safety policies dictate that these types of occurrences must be classified as "accidents" since a major component had to be shipped to a third line facility for maintenance work. It is assessed that this policy is skewing the statistics since, in at least one occurrence, the engine had not been damaged. The Directorate of Flight Safety staff are preparing a revised policy which will more accurately classify accidents and incidents.

The Human Factor Analysis and Classification System (HFACS) was introduced in January 2004. HFACS was designed to identify not only the active cause factors that directly resulted in the occurrence, but also the latent cause factors which contribute to the final sequence of events and

"predispose" the accident or incident to occur. By identifying latent cause factors, it is felt that problems with issues such as resources, organizations, processes, infrastructure, equipment and training can be identified and mitigated in order to improve flight safety. However, this system is still relatively new and it is obvious that Flight Safety staffs are having difficulties with this classification system. The main problem is that the analysis of occurrences is still focussed on the active failures at the expense of the latent failures. The flight safety staffs in the Directorate and at1 Canadian Air Division Flight Safety staffs are examining methods of correcting this problem through education of flight safety staffs and revision of processes.

An analysis of Human Factor Analysis and Classification System data revealed that the majority of active cause factors fall into three categories: Attention/Memory; Decision Errors and Technique Based errors. Attention/Memory errors occur where the individual omitted a step in a procedure or failed to apply appropriate attention to a given task. Decision errors are based on decisions that are not covered by regulation or procedures and are discretionary on the part of the decision maker. Technique errors involve operation, workmanship or mechanical skills below the level that can reasonably be expected from a person with the proper training and experience. Although an in depth analysis of the data has not been completed, these trends would be expected given the relatively low experience levels, high personnel tempo for some critical groups and reduced proficiency levels that the Air Force is currently experiencing.

One item of major concern is the number of cause factors related to the routine deviation from orders. This type of cause factor is assigned when rules and regulation transgressions are routine/habitual for the individual concerned and may be condoned by supervisory staff. It has also been termed “rule-bending”. This disturbing number can, in some cases, be attributed to poor supervision which is also an elevated cause factor. DFS will conduct a more in-depth analysis of this issue during the coming year.

A brief analysis was conducted on the type of occurrences for each aircraft fleet. All major concerns were raised during the Airworthiness Review Board fleet review. Two common themes were identified.

- First, there was an increase in the number of occurrences related to survival and safety equipment in several fleets. This analysis reinforced a concern noted in a number of recent Flight Safety Investigation Reports in which Aviation Life Support Equipment was deficient. The Directorate of Flight Safety staffs is actively investigating this issue with the Operational Airworthiness Authority and the Technical Airworthiness Authority staffs.
- Second, several fleets suffered from a high number of occurrences of panels/doors left unsecured for flight. The Flight Safety Directorate staff have identified a requirement for further research on this issue.

In summary, while the Flight Safety Program itself appears to be healthy, there are a number of flight safety concerns. Many of these concerns are assessed to be related to previously identified problems such as low experience levels and high personnel tempo. However, additional work needs to be conducted in some areas. Accordingly, The Directorate of Flight Safety will:

- review the accident classification system and forward recommendations for a revised policy to the Chief of the Air Staff ;
- in conjunction with 1 Canadian Air Division Flight Safety Officer, revise the investigation processes and the education of investigators such that the Human Factor Analysis and Classification System are improved;
- conduct an in depth analysis of the routine violations cause factors to determine what can be done to reverse this disturbing trend;
- conduct an in depth review and analysis of Aviation Life Support Equipment concerns and forward a report under separate cover to the Chief of the Air Staff, Commander of 1 Canadian Air Division and Director Aerospace Equipment Program Management; and
- conduct an analysis of the “doors/panels open” problem.

In conclusion, this is the first report of this nature. There are no doubt areas in which improvements can be made. Accordingly, feedback on this report would be greatly appreciated.

2005 FLIGHT SAFETY ANNUAL REPORT

1. AIRWORTHINESS PROGRAM

1.1 INVESTIGATIONS

1.1.1 AIA Investigations

During the calendar year 2005, the Airworthiness Investigative Authority (AIA) initiated two joint investigation with the Transportation Safety Board (TSB) and eighteen investigations: ten accidents (Two category ‘A’ damage, one ‘B’, five ‘C’ and two serious injuries) and eight incidents (seven ‘D’ and one ‘E’). Table 01 outlines the investigations initiated during the year followed by a synopsis of each one.

During the same period, 18 investigations were completed. In addition to the AIA initiated investigations, approximately 600 D Cats and 2400 E Cat occurrences were reported in 2005. All of these occurrences were investigated with the exception of approximately 275 which were recorded as "For Tracking Purposes Only".

#	DATE	SEVERITY	DAMAGE	SERIOUS INJURY	AIRCRAFT	EVENT
1	13 Jan 05	Incident	Cat ‘D’		Hornet	Landing incident
2	28 Jan 05	Incident	Cat ‘D’		Cormorant	Sheared Bolt
3	2 Feb 05	Accident	Cat ‘E’	1	Buffalo	Jumping accident
4	10 Feb 05	Accident	Cat ‘C’		Griffon	Uncommanded Engine acceleration
5	26 Mar 05	Incident	Cat ‘D’		Bellanca	Landing incident
6	4 Apr 05	Incident	Cat ‘D’		Cormorant	Severe Vibration
7	1 May 05	Accident	Cat ‘B’		Glider	Winch power lost
8	1 May 05	Incident	Cat ‘D’		Sperwer	Uncommanded recovery
9	22 May 05	Incident	Cat ‘D’		Bellanca	Landing
10	11 Jun 05	Accident	Cat ‘C’		Hercules	Ramp damage
11	23 Juin 05	Accident	Cat ‘E’	1	Griffon	Jumping
12	16 Aug 05	Accident	Cat ‘A’		Hornet	Lost of control (LOC)
13	24 Aug 05	Accident	Cat ‘A’		Tutor	Engine failure
14	25 Aug 05	Accident	Cat ‘C’		Griffon	ITT Exceedance
15	14 Oct 05	Accident	Cat ‘C’		Sperwer	Landing into tree
16	17 Oct 05	Accident	Cat ‘C’		Tutor	Airframe overheat
17	30 Nov 05	Incident	Cat ‘D’		Griffon	Compressor stall
18	6 Dec 05	Incident	Cat ‘E’		Griffon	ITT Exceedance

Table 01 – List of 2005 AIA Initiated Investigations.

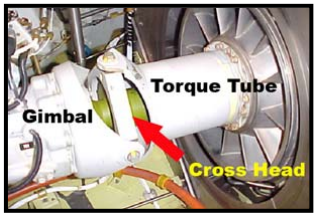
1.1.1.1 13 Jan 05, CF188933 Hornet, Incident, Cat 'D', Oklahoma, USA, Case ID # 119801

The Pilot in Command (PIC) and second pilot were enroute from Cold Lake, Alberta, to Naval Air Station Key West, Florida as part of an exercise deployment. An enroute fuel stop was planned at Tinker Air Force Base (AFB), Oklahoma. Approximately 100 Nautical Miles (NM) from Tinker and at an altitude of 39,000 feet, the crew experienced indications of right engine oil pressure fluctuations. The checklist items were actioned and the right engine was shut down. The crew declared an emergency and began their descent requesting a landing via a visual straight in approach to the threshold of runway 12 at Tinker AFB. The PIC flew a visual straight-in half-flap approach at approximately 150 knots indicated airspeed. At approximately 1.5-2 NM from the threshold of runway 12, the PIC was still unable to visually locate the arrestor cable which he expected to be identified by the Canadian Forces' standard of an orange circle painted on a black backed cube marker on either side of the arrestor cable. Just prior to touchdown, the aircraft's arrestor hook caught the arrestor gear cable in the undershoot area of runway 12. The aircraft came to a stop on the runway and the pilots egressed uninjured. The aircraft sustained 'D' category damage.

The Flight Safety Investigation revealed that the CF18 crew were unaware that the tail-hook touchdown point can be over 500 feet prior to the intended aim-point (depending on variables such as glide path angle, and angle of attack). Recommendations include amending manuals to ensure aircrew are aware of the difference in touchdown points.

The engine oil pressure fluctuations were caused by a faulty connector which had failed due to a cracked oil pressure transmitter bracket. False oil pressure indications have resulted in approximately 15 single-engine landings over the past five years. Recommendations include a re-design of the transmitter bracket, and modifications to the inspection procedures. This FSIR was signed off on 05 April 2006.

1.1.1.2 28 Jan 05, CH149901 Cormorant, Incident, Cat 'D' , Comox, BC,Case ID # 120020



While conducting a daily inspection on CH149901, the technician noticed oil coming from the # 3 engine drain line. The # 3 engine oil level was checked and found to be low. Further investigation revealed that one of the engine torque tube crosshead bolts had sheared. The sheared bolt was in the 6 o'clock position connecting the crosshead assembly to the torque tube assembly. The components from this subject occurrence have been forwarded to the Original Equipment Manufacturer (OEM) for inspection. In addition, engine and transmission specialists from the OEM will deploy to the Main Operating Base to perform engine alignment checks and inspect the # 3 engine input to the main gearbox. This occurrence remains under investigation.

1.1.1.3 2 Feb 05, CC115457 Buffalo, Accident, Cat 'E', 2 injuries, Comox, BC, Case ID # 120100,

On 02 February 2005, 442 Transport and Rescue Squadron was conducting unit training with a CC115 Buffalo aircraft to maintain crewmember proficiency/currency. While training, a team of

two Search and Rescue Technicians (SAR Techs) performed a parachute descent into the "South

In-field" Drop Zone of the 19 Wing, Comox airport. Both SAR Techs encountered a low level wind shear, which caused them to drift back over the built up area of the Hangar line. The first SAR Technician impacted the cement apron in front of 14 Hangar at an increased rate of descent and sustained serious injuries. The second SAR Technician landed downwind of 14 Hangar in the parking lot adjacent to the commissionaires building. He conducted a parachute-landing fall between parked cars and was dragged approximately 4 feet before cutting away his main canopy. He sustained minor injuries. This investigation was completed on 28 June 2006.

1.1.1.4 10 Feb 05, CH146467 Griffon, Accident, Cat ‘C’. Thedford Mines, QC, Case ID # 120200

A Griffon helicopter was positioned at the Thedford Mines Airport in support of a deployed field

training exercise. The crew was tasked to carry out a weather check and proceeded to the aircraft for the pre-flight check and start.

Number two engine was started first, the throttle was advanced and the generator turned ‘on’. The crew then proceeded to start number one engine and, after approximately five seconds, number two engine began an uncommanded engine acceleration (UEA). The co-pilot immediately rolled back the throttle on number two to idle but the engine continued to accelerate. The pilot then called for a shut down. The crew noticed the maximum Rotor RPM attained to be near 120 %.

This occurrence was the seventh case of uncommanded engine acceleration that winter. A cold weather start procedure previously used on the Griffon had been removed following modifications done on the Fuel Control Unit (FCU). It appeared that the modifications were ineffective in preventing UEA. The cold weather start procedure was re-instated by NDHQ on the day of this occurrence, 10 February 2005. No other UEAs have been reported since. This investigation was completed on 25 April 2005.

1.1.1.5 26 Mar 05, BL28 C-GXZK Bellanca Scout, Incident, Cat ‘D’, Mountainview, ON, Case ID120735

The Bellanca Scout tow plane had just launched after a crew change in support of the annual

ACGP (Air Cadet Gliding Program) familiarization flying program. The incident flight was the pilot's first flight of the day. The planned flight, conducted under day VFR rules, was to tow a glider to circuit altitude and conduct a simulated rope break. The flight proceeded normally with the glider releasing at 1000' AGL. The tow plane then followed the glider with a wide circuit to a normal approach and final. Upon landing, the pilot attempted to correct the ground tracking of the aircraft and in doing so, the aircraft nosed over and slid to a stop.

It was determined that the cause of this event was that brakes rather than rudder were used to correct the aircraft's directional track. Further, heavy breaking was applied when the aircraft was

going off of the runway and the brakes were not released quickly enough to prevent the aircraft from nosing over.

An important training factor was that the Army L-19 video was not shown to all personnel in accordance with the 242 ACGP manual. Although dated, this film does cover this brake usage and nose over problem. This enhanced SR was closed on 18 October 2005.

1.1.1.6 4 Apr 05, CH149913 Cormorant, Incident, Cat 'D', Trenton, ON, Case ID # 120812

During operation of a Cormorant, severe vibrations rapidly developed during ground taxi. As

increasing and reducing collective setting and turning off the Active Control of Structural Response (ACSR) did not eliminate the vibration, an emergency shutdown was carried out. A complete inspection was then conducted with no damage or unserviceabilities detected other than a low nose landing gear oleo. Following servicing of the oleo, the aircraft was released for a ground taxi.

The crew experienced moderate to severe vibrations on the ground during Taxi. The aircraft was shutdown and the FE carried out an additional tail rotor pre-flight inspection and discovered that three of the tail rotor blades were cracked.

1 Cdn Air Div HQ accepted potential for further damage to the aircraft CH149913 through a Risk Assessment to determine the level of risk associated with the operation of CH149913 in its current condition and configuration with the intent of inducing vibrations. The maximum risk associated with ground operation on aircraft CH149913 was assessed as "Medium". Although the cause is undetermined, a 1 Cdn Air Division message was released to all CH149 operators and support units to highlight the seriousness of severe or unusual aircraft vibrations. This message provided directions to take appropriate emergency actions to avoid these types of vibration events. Directions were also provided to report any vibration to the technical authority before initiating any maintenance actions as well as filing a FS message. Furthermore, crews were not to recreate the vibration event without specific direction from the technical authority. This investigation was completed on 04 August 2005.

1.1.1.7 1 May 05, SZ-23 C-GFMC, Accident, Cat 'B', Netook, AB, Case ID # 121147

The mission was a winch launch and circuit for two qualified glider pilots. Immediately after

becoming airborne, at approximately fifteen feet above ground level, the aircrew felt a loss of power from the winch. The pilot manually released the tow cable and lowered the nose of the glider in an attempt to land straight ahead. The glider over-flew the towrope, and the tail-wheel of the glider became entangled in the towrope recovery parachute. The winch, which had suffered a momentary power loss, recovered and surged to normal power. As the winch surged it pulled on the tail-wheel, which caused the glider to rotate 360-degree about it's lateral axis. The glider impacted the ground in a flat attitude with very little forward speed. Both glider occupants were treated and released from a local hospital. This accident is under investigation.

1.1.1.8 1 May 05, CU161007 Sperwer, Incident, Cat 'D', Cold Lake, AB, Case ID # 121172

The mission was flown as part of the Test and Evaluation of Sperwer UAV CU161007. The

purpose of flight was to determine Maximum Link Range and Recovery Accuracy. The UAV had reached the furthest waypoint at approximately 80 km without incident and was 9 km into the first leg of the return flight. As per the test plan, a Griffon helicopter was following the UAV throughout the flight. When the aircraft was at 11,200 ft MSL approximately one hour and seven minutes into the test flight (2356Z) the observers in the helicopter reported normal UAV parachute deployment and recovery. At the same time the Ground Control Station lost all telemetry. The UAV landed within the Cold Lake Air Weapons Range in a wooded area of 60-foot trees. The UAV suffered a complete electrical failure, which caused the UAV to enter an uncommanded recovery. This investigation was completed on 26 July 2005.

1.1.1.9 22 May 05, B28 Scout C-GQSC, Incident, Cat 'D', Iroquois Falls, ON, Case ID # 121428

The Bellanca Scout had completed the last glider tow of the day and was returning to land. The

pilot lined up on final and landed on runway 14. At approximately 1815Z the aircraft was on the rollout from the landing when it nosed over. The aircraft came to rest on its nose and main wheels, approximately 1048 feet from the departure end of runway 14. This investigation was completed on 31 January 2006. The cause was attributed to human factors and capture under the Human Factor Analysis & Classification System (HFACS) yielding three actives (Unsafe Act) and four latent (Three mental states and one environment) causes.

1.1.1.10 11 Jun 05, CC130332 Hercules, Accident, Cat 'C', Trenton, ON, Case ID # 121707

During the conduct of the pre-flight inspection on the aircraft the Flight Engineer (FE) attempted

to manually close the ramp which had some pulled circuit breakers. A technician inspected the ramp area and discovered the ramp locks were extended and damage had occurred to the ramp lock area and sloping longerons when the ramp was closed. The reason for the pulled circuit breakers was not confirmed with maintenance prior to attempting to close the ramp. This investigation was completed on 27 October 2005.

1.1.1.11 23 Jun 05, CH146439 Griffon, Accident, Cat 'E', 1 Injury, Lac St-Jean, QC, Case ID # 121880

During a SAR para-jump training mission, the SAR Technician undershot the drop zone (DZ) and landed on rocks, sustaining serious injuries. He was evacuated by Griffon helicopter to the 3 Wing Bagotville hospital. The effects of the confined area's challenges, combined with inadequate wind assessment, overloaded the SAR Tech

during his final approach to the DZ. In an effort to cope, some technique-based errors were made in para-landing procedures which contributed to his off-DZ landing and subsequent injuries.

Safety actions taken include the release of a message clarifying SAR Tech qualifications with respect to confined area operations. Outstanding safety recommendations include amendment to the WFO to address ambiguity pertaining to WDI requirements.

1.1.1.12 16 Aug 05, CF18745 Hornet, Accident, Cat 'A', Bagotville, QC, Case ID # 122639

The accident aircraft was the number two aircraft of a two-plane Basic Fighter Manoeuvres (BFM) mission. The mission took place in the Saguenay Training area approximately 60 nautical miles to the northeast of 3 Wing Bagotville. During the first engagement, the accident aircraft was in the defensive role. The accident aircraft conducted an initial defensive break turn, followed by a more aggressive defensive manoeuvre. During this latter manoeuvre, the aircraft departed controlled flight and entered a flat spin at about 13,000 ft above mean sea level (MSL). The pilot was unable to regain control of the aircraft and subsequently ejected from the aircraft as it descended through approximately 7,500 feet MSL. The aircraft continued to descend in a flat spin condition and was destroyed on ground impact. The pilot landed safely and suffered minor injuries. The pilot was extracted from the site by a CH146 helicopter from 439 Squadron approximately 40 minutes after the ejection and transported to medical facilities in Bagotville. The accident is under investigation.

1.1.1.13 24 Aug 05, CT114120 Tutor, Accident, Cat 'A', Thunder Bay, ON, Case ID # 121771

The accident aircraft was flying the "opposing solo" position for 431 Air Demonstration Squadron and was preparing to participate in an eight-plane display that was to take place at the Thunder Bay, Ontario waterfront. Immediately after achieving the inverted flight position, number 8 heard a loud bang and felt immediate loss of thrust. The pilot depressed the airstart button and the aircraft was returned to upright flight with the engine RPM quickly decaying to between 2 and 3 percent. Other emergency procedures were ineffective so the pilot steered the aircraft towards an uninhabited area and he ejected. The aircraft impacted the ground 10 seconds later near some derelict vehicles in a field about nine kilometres north of the Thunder Bay airport and was destroyed. The pilot landed about ½ kilometre northeast of the aircraft and was recovered with minor injuries sustained in the ejection sequence about 20 minutes later. This accident is under investigation.

1.1.1.14 25 Aug 05, CH146457 Griffon, Accident, Cat 'C', Edmonton, AB, Case ID # 122777

The flight of occurrence was a tasked mission in support of 3PPCLI paradrop mission with water

entry over Lac Ste-Anne. The flight plan was to take-off from Namao Airfield, proceed to Lac St-Anne, land, shut down and configure the aircraft for paradrop. Extra Flight Engineers from the squadron were also carried on board to allow them to qualify on paradrop as collateral training. The pilot was seated on the left with co-pilot on the right seat. The co-pilot carried out the engine start and post-start sequences from the right seat with the flight engineer while the pilot entered Computer Display Unit (CDU) data. Engine number one was started first with no incident noted. Engine number two was started normally. Only a slightly low N1 engine RPM was noted (59 % vs 61 % plus or minus 1%). The required Engine Fuel Control check was carried out in accordance with standard procedure. Throttle was advanced slowly and immediately a rumbling/grumbling noise was heard and number two engine Inter Turbine Temperature (ITT) was observed rising rapidly. Number two engine was immediately shut down using hot start procedure to assist in cool down and the aircraft shut down was completed without further incident. This accident is under investigation.

1.1.1.15 14 Oct 05, CU-161007, Accident, Cat ‘C’, Wainwright, AB, Case ID # 123617

After completing a normal training mission in support of Brigade Training Exercise 05 in Camp

Wainwright AB, the Sperwer Uninhabited Aerial Vehicle (UAV) CU161007 drifted into trees during the manual mode recovery executed from 200 meters Above-Ground-Level (AGL). The aircraft drifted 288 meters from the planned recovery point. It settled against a copse of small birch trees and suffered “C” Category damage. This accident is under investigation.

1.1.1.16 17 Oct 05, CT114035 Tutor, Accident, Cat ‘C’, Moose Jaw, SK, Case ID # 123644

About 15 minutes into the flight during a roll out from inverted flight the pilot received Master

Caution, Master Warning, Fire, Upper Airframe Overheat and Lower Airframe Overheat annunciator lights. The pilot carried out the red page checklist items (Throttle minimum required/speed brake switch “OFF”/check for secondary indications of fire.) The engine continued to run normally and there were no other indications of fire (smoke in cockpit or visible smoke behind aircraft) so the pilot climbed at 85% power towards the Moose Jaw Airport. Had the existence of a fire been confirmed the next checklist item is “EJECT.” The upper mast assembly was found cracked which allowed a mixture of fuel and air to be exposed to the high engine temperature in Zone 2 and started a fire. This investigation was completed on 02 December 2005.

1.1.1.17 30 Nov 05, CH146460 Griffon, Incident, Cat ‘D’, Edmonton, AB, Case ID # 124362

The aircraft was on the Helipad, facing into the wind, with both governors in the auto position.

As the pilot advanced both throttles, two loud bangs were heard from #1 engine. The pilot held the throttles in position and the indications ceased. Following this the throttles were reduced resulting in three

loud bangs coming from the #1 engine. Other secondary indications were airframe shake. Interstage Turbine Temperature fluctuations were found to be within the green arc. The aircraft was then shut down. This investigation was completed on 01 June 2006 and revealed that the helicopter engine suffered a compressor stall caused by foreign object damage (FOD).

1.1.1.18 6 Dec 05, CH146462 Griffon, Incident, Cat ‘E’, Edmonton, AB, Case ID # 124363

During an Advanced Night Vision Goggle flight test during the early morning hours of 06 December 2005, near Warspite AB, a low side governor failure on the #1 engine was simulated. While carrying out the checklist actions, an Interstage Turbine Temperature spike, which exceeded operating limits, occurred. This investigation was completed on 5 Jun 2006 and the cause is undetermined.

1.1.2 Joint Investigations

The AIA participated in two joint accident investigations with TSB as follows:

1.1.1.19 16 Jun 05, F-16 Non CF, Incident, Cat ‘E’, Cold Lake, AB, Case ID # 121791

The first investigation involved an occurrence which took place 16 June 2005 during an exercise Maple Flag training scenario at 4 Wing Cold Lake. During the exercise, a single fighter aircraft and an element of two other fighter aircraft exited the lateral boundaries of the assigned exercise airspace. During the airspace "spillout" all three fighter aircraft lost separation with a Northwest Airlines Boeing 757 which was transiting from Fairbanks AK to Minneapolis-St Paul MN on RNAV route NCA13 at FL370. The occurrence was documented through normal Exercise Maple Flag reporting lines and a CF flight safety occurrence was filed. Subsequently, a flight safety supplemental report was completed by the 4 Wing Flight Safety Officer (WFSO). A NAV Canada aviation occurrence report was also filed. Transportation Safety Board (TSB) requested that a combined DND/TSB investigation be conducted into this occurrence. This was agreed and DFS issued a flight safety investigation tasking order to conduct a more in depth investigation. The result of this investigation was an Enhanced Supplementary Report.

1.1.1.20 10 Jul 05, Non CF, Accident, Cat ‘A’, Moose Jaw, SK, Case ID # 122118

The second investigation involved an occurrence at the Moose Jaw/Air Vice Marshal C.M. McEwen Airport during the Saskatchewan Air Show on 10 July 2005. A display team comprised of three United States-registered aircraft were engaged in a simulated dogfighting display consisting of a series of crosses and chases. During one of the manoeuvres, two of the aircraft collided near show centre. Both aircraft caught fire and crashed between the 1500-foot show line and the outer runway. Both pilots were killed at impact, and both aircraft were destroyed. TSB and the AIA decided to conduct a combined investigation lead by TSB. Accordingly a DFS aircraft accident investigator was a member of the accident investigation team.

1.1.3 Investigation Reports Activities

Table 2 outlines the status of ongoing investigation.

DATE	AIRCRAFT	DESCRIPTION	ACTIVITIES
27 May 03	CF188733	Cold Lake, AB - Boroscope plug not replaced.	Final FSIR being prepared
26 May 03	CF188732	Cold Lake, AB - Loss of control and crash during Ex Maple Flag.	Final FSIR completed
31 Jul 03	C-GFME	Picton, ON - low level release from tow plane	Final FSIR being translated
14 Aug 03	C-GCSD	Debert, ON - student hit tree on base leg.	Final FSIR completed
28 Aug 03	CH146434	Valcartier, QC - cargo door came off in flight.	Final FSIR completed
29 Mar 04	CH146493	Engine Fire after simulated emergency.	Final FSIR completed
20 Mar 04	CU161002	UAV failed to climb after launch.	Final FSIR being prepared
14 May 04	CT155202	Moose Jaw, SK - bird strike on touch and go.	Draft for comment being prepared
19 Jun 04	CF188761	Yellowknife, NT - pilot ejected after experiencing control problems on landing.	Draft for comment being prepared
30 Jun 04	CU161004	UAV went to emerg. recovery mode after loss of comms.	Draft for comment being prepared
20 Sep 04	CH149908	Gander, NL - SAR Ops hoist from life raft.	Final FSIR being prepared
31 Oct 04	CFARD	Hard landing during simulated premature cable release practice	Final FSIR being prepared
10 Dec 04	CT114064 CT114173	Mossbank, SK - Snowbird 8 & 9 collided mid-air	Draft for comment being prepared
13 Jan 05	CF188933	"D" Category. Arrested landing at Tinker AFB.	Final FSIR completed
02 Feb 05	CC115457	Comox, B.C. - Sar Tech Injury	Enhanced SR completed
01 May 05	C-GFMC	Olds, AB – tow-rope chute became entangled in tail-wheel of glider	Final FSIR being translated
16 Aug 05	CF188745	Bagotville, QC - Aircraft departed controlled flight. Pilot ejected from flat spin.	Draft for comment being prepared
24 Aug 05	CT144120	Thunder Bay, ON – Snowbird crash, pilot ejected.	Draft for comment being prepared
29 Aug 05	CH146457	Edmonton, AB – Compressor Stall with high TIT	Enhanced SR being prepared
30 Nov 05	CH146460	Edmonton, AB – Compressor Surge	Enhanced SR being prepared
06 Dec 05	CH146464	Petawawa, ON – Overtemp during start	Enhanced SR being prepared
31 Jan 06	CU162031	Gagetown, NB – UAV elevator separated in flight	Enhanced SR being prepared
02 Feb 06	CH12438	Denmark – Ditching (30NM EST of Denmark Coast)	Draft for comment being prepared
08 Feb 06	CH146468	Valcartier, QC - Hard Landing	Enhanced SR being prepared
14 Feb 06	CH146480	Trenton, ON – Vehicle back into helicopter	Enhanced SR being prepared
25 Apr 06	CC130311	Alert, NU – Runway Overrun	Draft for comment being prepared
28 Apr 06	CU161009	Operational, AFG	Draft for comment being prepared
11 May 06	CC130313	Greenwood, N.S. - Ladder failed	ESR being prepared
23 May 06	CU161011	Operational, AFG	Preliminary being prepared

Table 02: Investigation Report Status

1.2 AIA ACTIVITIES

Bill C-6, a proposed amendment to the Aeronautics Act, received first reading in the House on 27 April 2006. Second reading was started in early May and is expected to continue in the fall of 2006. While Transport Canada is the lead department on this initiative, the proposed amendments will, if adopted, address several Department of National Defence (DND)

airworthiness concerns. These issues include additional powers for AIA appointed investigators, better procedures for dealing with civilian companies and the next of kin of personnel killed in CF aircraft accidents, confirmation of the "privileged" status of flight safety information, processes to enhance the conduct of DND/TSB co-ordinated investigations and the ability to sub-delegate airworthiness authorities. Speeches for the Minister, Parliamentary Secretary and a Member of Parliament have been submitted to support the second reading.

The AIA continues to work closely with Aerospace Engineering Test Establishment (AETE), Quality Engineering Test Establishment (QETE), National Research Council (NRC), Defence Research and Development Canada (Toronto) DRDC(T) and Transportation Safety Board (TSB).

1.2.1 Airworthiness Instructions, Standards and Authorities

The AIA has been tasked to issue airworthiness instructions and standards and to assign investigative authority to organizations and individuals. While these tasks are being done, the manner in which they are being done has not yet been formalized and documented. Accordingly, work has started on the production of an Airworthiness Investigative Manual (AIM) to correct this problem. It is anticipated that the first version of this document will be produced in late 2006.

1.2.2 Airworthiness Deficiencies

At the 2005 AAB, it was determined that the CF Cockpit Voice Recorder (CVR) / Flight Data Recorder (FDR) policy was deficient and that this policy was a critical airworthiness requirement. As directed by CAS at the 2005 AAB, a newly mandated CVR/FDR Working Group has been established to develop a revised, practical policy as well as a detailed schedule outlining the way in which this revised policy will be implemented. Terms of Reference for this Working Group have been developed and signed by CAS on 31 January 2006. DFS was appointed as the chairperson of the CVR/FDR Working Group. The CVR/FDR Working Group adopted a four-phase approach to complete the task. These phases are as follows:

- Phase 1 - identify aircraft families;
- Phase 2 - develop the standard for each family;
- Phase 3 - develop a new CVR/FDR Policy; and
- Phase 4 - implement the new policy by comparing actual fleet capabilities with each standard and determining the way ahead for each fleet.

The Working Group has completed phase 1 and work is well underway on phase 2.

1.2.3 Surveys

Flight Safety surveys were conducted at two contractor sites (L3 Com, Edmonton and Field Aviation Calgary), as part of the DFS continuous contractors visit program, during the past year. The purpose of these surveys is to examine the quality of the Flight Safety Program, to make recommendations for enhancements to this program and to contribute to the production of an

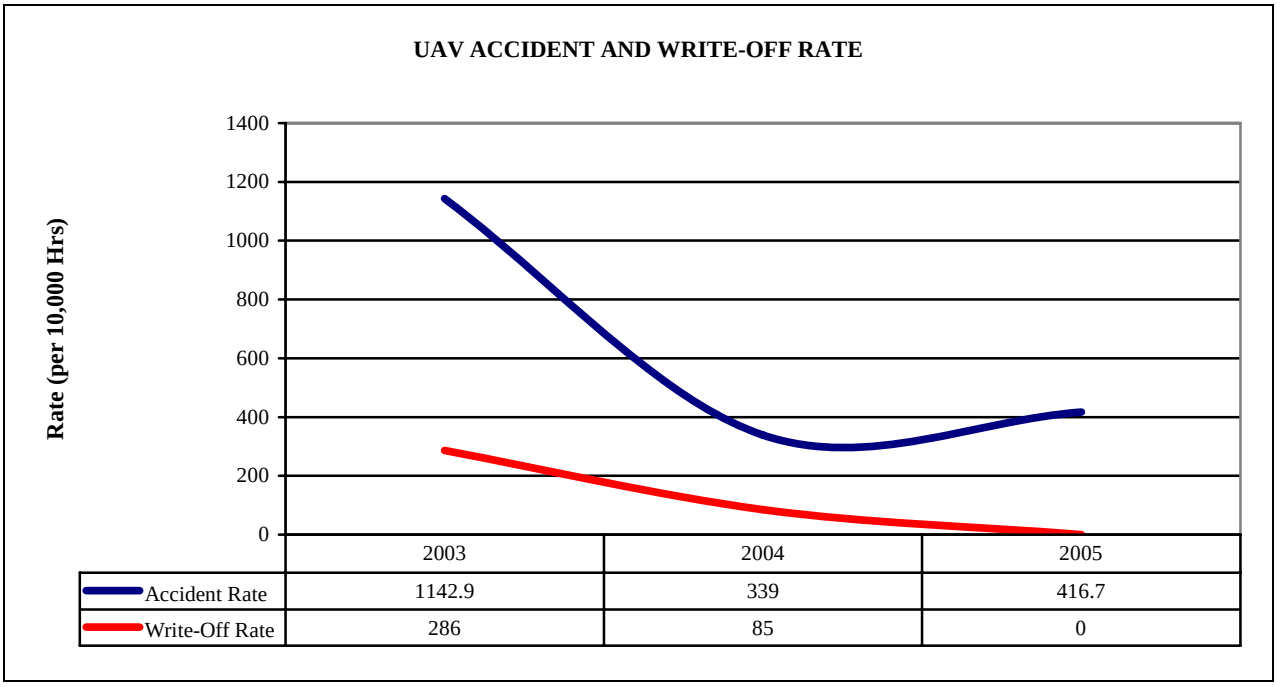
airworthy product.

1 Canadian Air Division Flight Safety conducted surveys at 17 Wing, 19 Wing plus 400, 408 and 427 Squadrons to which members of DFS participated.

1.3 OTHER STATISTICS

1.3.1 Unmanned Aerial Vehicule (UAV)

The write-off rate for UAVs dropped to a record low, with no aircraft being lost in 2005. There were two accidents in 2005. Two Sperwer were damaged (one Cat 'C' and one Cat 'D') Despite this, the accident rate increased from 339 to which resulted in an accident rate of 416 per 10,000 hours flown. Although this rate is dramatically higher than that of manned aircraft, one must consider that the program is in the initial stage of operational employment, and that the aircraft operate at a much higher risk level. Aircraft accreditation took place in 2004, and higher rates in 2005 were the result of testing/training prior to operational deployment. Over the short lifespan of the UAV operations in the CF/DND, significant improvements were noted in 2005. UAV statistics are not included in subsequent section and statistics.



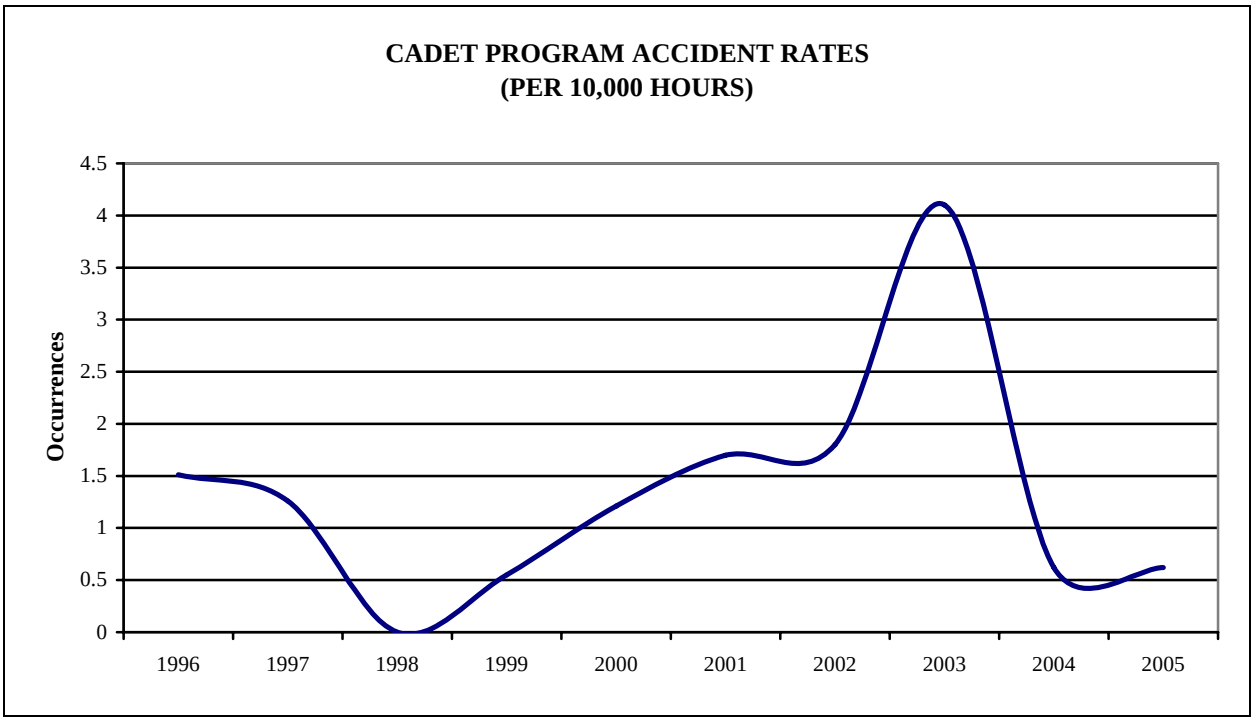
Graph 01 – UAV Accident Rate and Write-off Rate

1.3.2 Air Cadet Program

They were one B Category accident and 85 incidents (23 D-Cat and 62 E-Cat) involving cadet operations for all Canadian regions. Table 3 below provides a 10-year summary of flying hours and occurrences. The Cadets Logged 16,149 hours in 2005 and have maintained an accident rate of 0.62 per 10000 hours flown for the second consecutive year with one glider accident for both years. Cadet operations are not covered in subsequent sections and are not counted in CF statistics.

DESCRIPTION	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Hours Flown	13221	15908	17498	18049	16590	17634	16662	17068	16033	16149
Glider Incidents	32	41	32	53	98	81	81	65	69	53
Glider Accidents	2	1	0	1	1	1	1	7	1	1
Tow Aircraft Incidents	20	34	19	33	39	33	33	41	32	32
Tow Aircraft Accidents	0	1	0	0	1	2	2	0	0	0

Table 03: Cadet Program Flying Hours and Occurrences Breakdown



Graph 02 – Cadet Program Accident Rates

2. FLIGHT SAFETY ACTIVITIES

2.1 PROMOTION

In an effort to increase the awareness of Air Force personnel, airworthiness was the central theme of the annual DFS briefing. This presentation was offered to all Wings, most bases and some establishments providing contracted maintenance services to the Department.

Four issues of Flight Comment magazine, and eight issues of Debriefing, the flight safety newsletter were published. A lot of extra content was added to the DFS website, including current and back issues of Debriefing, and all issues of Flight Comment dating back to its inception in 1949. All documents published on the website are now searchable for content. Further, changes to the website have raised the exposure and interest in the DFS site, now ranking first on Google for "Sécurité des vols" and sixth for "Flight Safety". In an effort to raise the awareness of the FS program, a series of new promotional products were purchased and

disseminated forces wide through the 1 Cdn Air Div FS staff.

Fifty-three Flight Safety award submissions were forwarded to DFS. These represented the acts of sixty-six different individuals. Based on the merit of the submissions, thirty-eight For Professionalism (FP) awards and five Good Show (GS) awards were granted. In all, fifty individuals received DFS approved awards and sixteen individuals were recommended for Squadron or Wing level awards. The DFS annual briefing was again employed as a major mechanism to promote flight safety. In 2005, all CF Wings and units, with the exception of 1 Wing HQ and 442 Squadron were provided with the DFS annual briefing. 1 Wing Headquarter (HQ) did not receive the briefing due to scheduling conflicts and 442 Squadron was not visited due to financial and scheduling constraints. In addition, briefings were provided to the North Atlantic Treaty Organisation (NATO) E-3 component in Geilenkirchen, Canadian Defence Liaison Staff (CDLS) London (as well as all CF exchange officers in the U.K.), CDLS Washington, DGAEPM and the Air Staff. In all, the DFS annual briefing was presented over 45 times in 2005. During the period Jan - Jun 2005, the theme of the presentation was Airworthiness. During the period Oct - Dec 2005, the theme was airmanship.

2.2 ANALYSIS

A Trending and Analysis cell has been created at DFS. The Directorate acquired industrial trending tools that will enable automated tracking and timely report generation for key flight safety indicators or concerns. The first of a new generation of quarterly report was published in Dec 05. The same tool was used to produce this annual report.

The Trending and Analysis cell has developed numerous custom-made reports to support strategic and tactical fleet concerns with respect to airworthiness. In 2005, custom made reports were developed for *ALSE, CF188 Planing Link Failures, Runway Incursions, Safety Measures Tracking* and *CT114 Engine Problems*.

2.3 EDUCATION

During the calendar year, 1 Canadian Air Division Flight Safety staff conducted 5 Basic Flight Safety Courses qualifying 131 students as Unit Flight Safety Officers/NCMs. This included 6 DND contractor staff, 12 Air Cadets, 4 Foreign Military and 7 Land Force personnel. The Air Division also conducted one Advanced Flight Safety Course of 23 students, which included 1 Air Cadet personnel. The Division Flight Safety Officer also presented Flight Safety related briefings to the Flying Supervisor’s Course, the Commanding Officer’s Course and Commander’s Combined Training Session.

2.4 MISCELLANEOUS

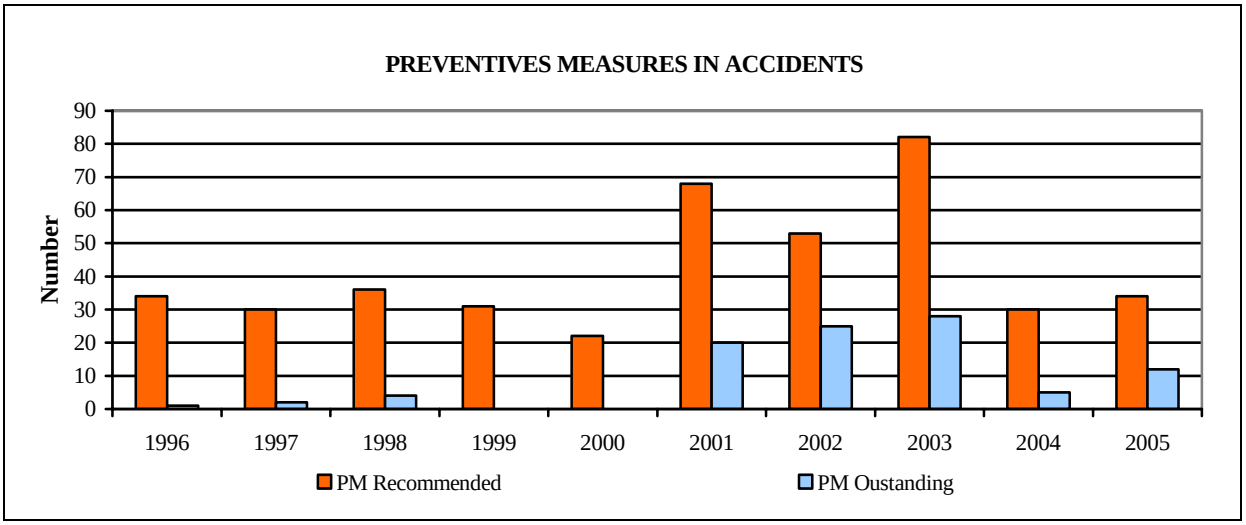
An A-GA 135-001/AA-001 (Part 1 - Flight Safety for the Canadian Forces) writing board was conducted in Ottawa during late February 2006. Following final review, the amended document will be published in fall 2006. This document will standardize the risk analysis process with the OAA and TAA processes. The document will be reformatted to become a practical handbook for the creation, conduct, and administration of a comprehensive Flight Safety program across the full spectrum of CF activities.

The Flight Safety Occurrence Management System (FSOMS) Working Group (held in Ottawa in late March 2006) recommended a list of short and long-term initiatives aimed at improving the functionality and usability of the application. The improved Preventive Measures capability of FSOMS 3.0.3 (scheduled for fall 06 release), coupled with new DFS tracking and reporting tools will significantly expand DFS Preventive Measure tracking capabilities. This will allow for an earlier identification of negative trends with the aim of proposing pro-active counter measures to the identified problem areas, and improve the tracking of the implementation of the Preventive Measures more closely from all sources.

DFS developed a prototype automatic Preventive Measures report generation capability using “Crystal Reports Enterprise" software and is collecting feedback on this system. This will provide a good interim solution to the final solution of seamlessly integrating into the FSOMS software.

2.5 TRENDS ON PREVENTIVES MEASURES

A significant amount of work has been done in closing accident investigations and implementing the preventives measures identified by these investigations over the last five years. The peak in 2002-2003 is attributable to the increased workload from a particularly bad year in 2001, where a high accident rate was experienced. Complex investigations, such as the one conducted on the CH146 accident in Goose Bay in 2002, resulted in multiple safety measures, which led to unusually high numbers for 2003. The increasing trend in 2005 reflects current investigations, and is not unusual, as a six month period is typically allotted to implement preventives measures. In summary, the situation with respect to outstanding recommendations is assessed as good.



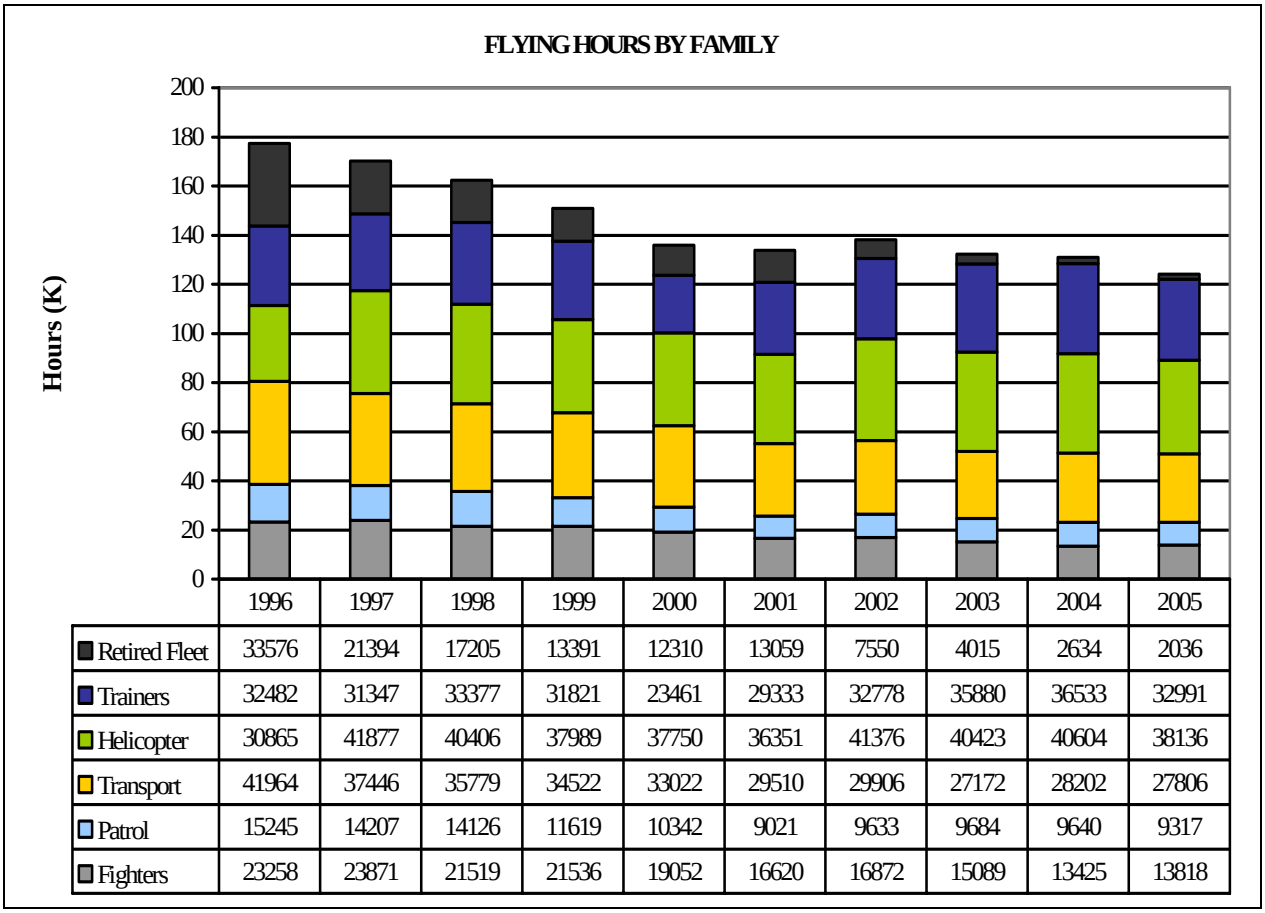
Graph 03: Preventives Measures in Accidents

3. STATISTICS AND TREND ANALYSIS

3.1 FLYING HOURS BY FAMILY

Although flying hours have been steadily decreasing over the last ten years, they have remained

fairly constant since 2001. It is significant to note that Trainer and Helicopter hours have remained fairly stable over the years, with Fighter, Patrol, and Transport fleets taking the majority of the cuts.

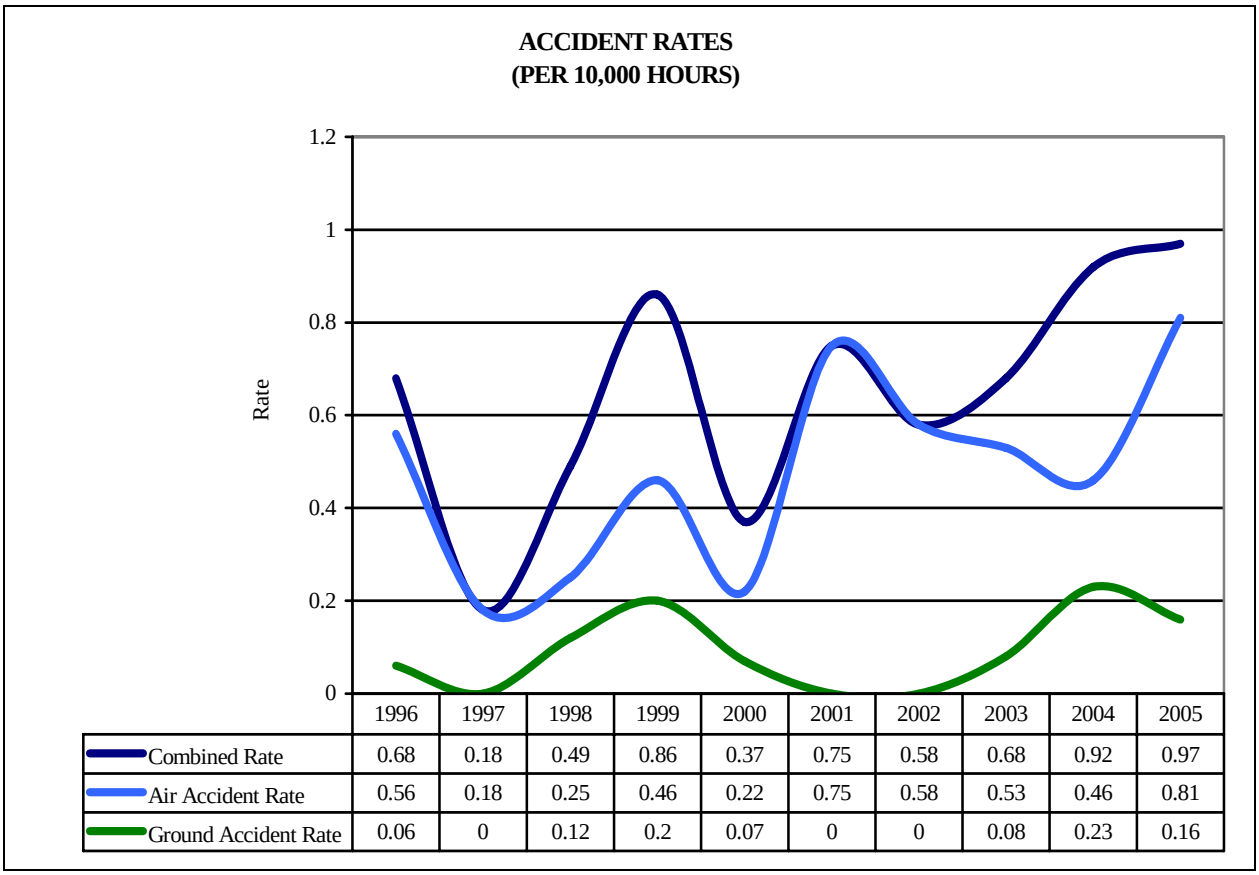


	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Retired Fleet	33576	21394	17205	13391	12310	13059	7550	4015	2634	2036
Trainers	32482	31347	33377	31821	23461	29333	32778	35880	36533	32991
Helicopter	30865	41877	40406	37989	37750	36351	41376	40423	40604	38136
Transport	41964	37446	35779	34522	33022	29510	29906	27172	28202	27806
Patrol	15245	14207	14126	11619	10342	9021	9633	9684	9640	9317
Fighters	23258	23871	21519	21536	19052	16620	16872	15089	13425	13818

Graph 04: Flying Hours by Family

3.2 AIR ACCIDENTS RATE

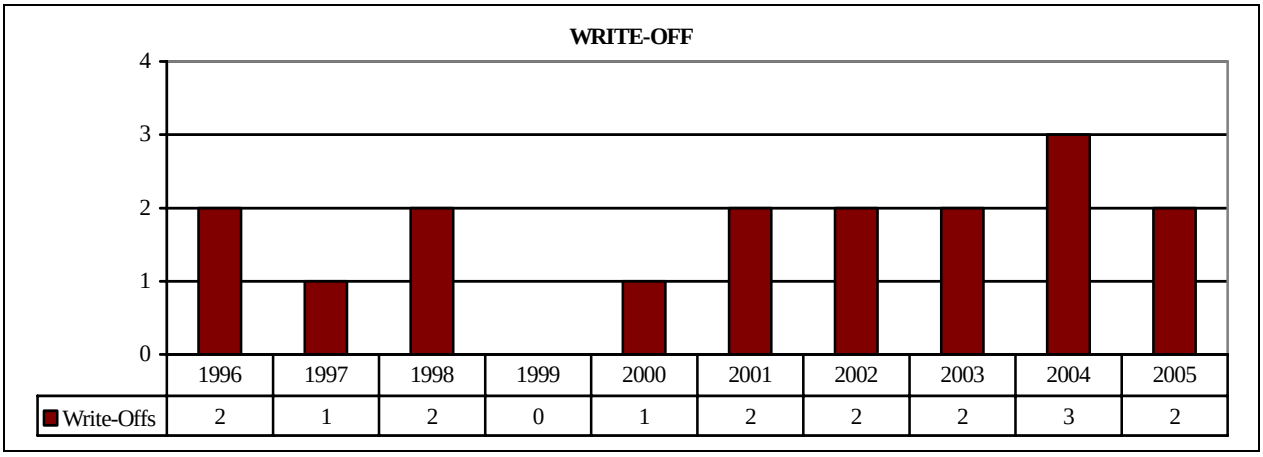
The air accident rate for 2005 was 0.81 per 10,000 flying hours, which is a 76% increase from the previous year of 0.46. The rate excludes cadets and UAV's occurrences. In addition, this rate is well above the 10-year average of 0.45. However, of the 10 accidents, four were attributable to a series of CH146 engine related incidents in which the engines had to be returned to third line facilities for maintenance due to the terms of the CH146 maintenance contract. According to current flight safety policies, these occurrences are automatically classified as C Cat accidents because a major component had to be shipped to a third line facility. DFS is drafting revisions to this policy to ensure that anomalies such as this do not skew the statistics. In addition, the actual level of damage in each of these accidents is being reviewed to ensure that each occurrence was in fact an accident. This occurrence rate may change as a result of this analysis. A further four were the result of serious SAR Tech / Flight Engineer injuries. While this is of concern, no significant trends were drawn from an analysis of these accidents. UAV and Cadet accidents were not included in these statistics.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Combined Rate	0.68	0.18	0.49	0.86	0.37	0.75	0.58	0.68	0.92	0.97
Air Accident Rate	0.56	0.18	0.25	0.46	0.22	0.75	0.58	0.53	0.46	0.81
Ground Accident Rate	0.06	0	0.12	0.2	0.07	0	0	0.08	0.23	0.16

Graph 05: Accident Rates

3.3 AIRCRAFT DESTROYED



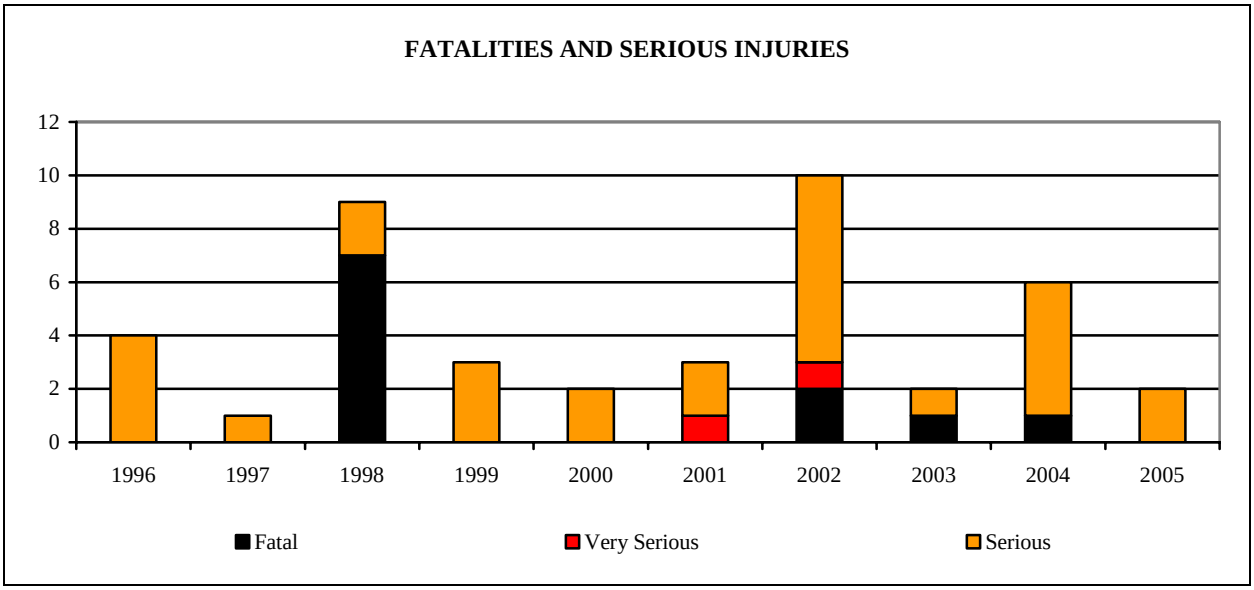
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Write-Offs	2	1	2	0	1	2	2	2	3	2

Graph 06: Write-Off

The number of aircraft destroyed in 2005 was two. Both were a result of accidents in August 2005: a CF188 in Bagotville, and a CT114 in Thunder Bay. There were no aircraft losses in any of the other fleets. While the objective is to reduce this number to zero, the 2005 statistics reveal that there is no significant deviation from the current norm (as shown in Graph 4).

3.4 FATALITIES AND INJURIES

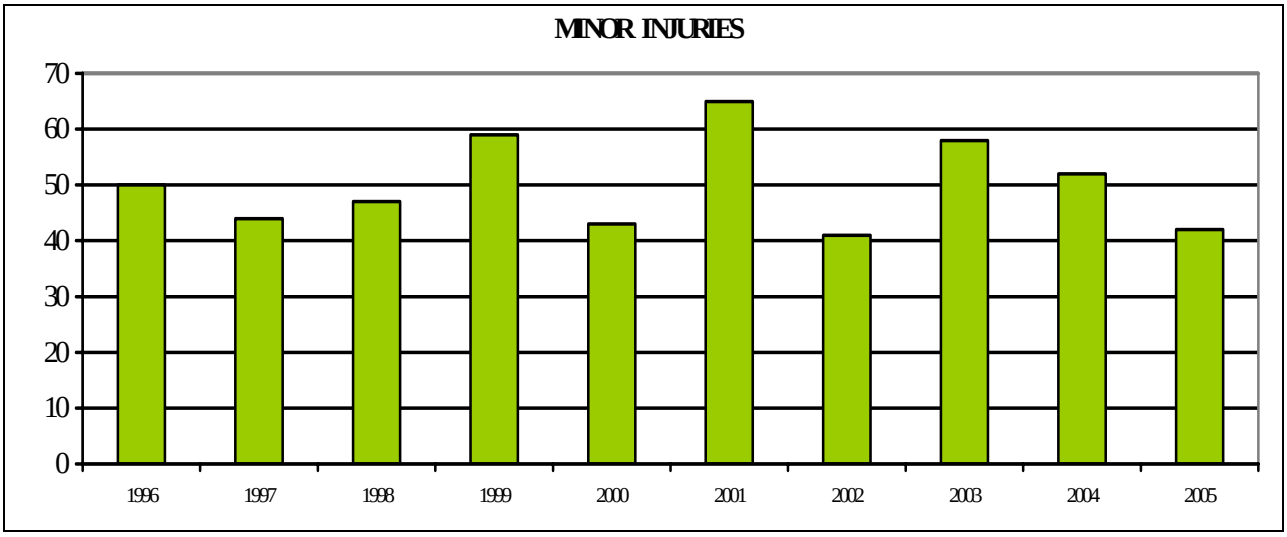
With the low write-off rate, came an accompanying low number of injuries in 2005. Despite these promising statistics, two serious injuries were reported. This is still a major concern although it is a slight decrease from the previous year. The injuries were experienced by SAR tech.



Graph 07: Fatalities and Serious Injuries

3.5 MINOR INJURIES

The number of minor injuries in 2005 represents a 10-year low of 42 (Graph 8). These types of injuries were predominantly experienced by ground/support personnel.



Graph 08: Minor Injuries

3.6 CAUSE FACTORS ANALYSIS

3.6.1 HFACS Analysis

The Human Factors Analysis Classification System (HFACS) was designed to identify not only the active cause factors that directly resulted in the occurrence, but also the latent cause factors which contribute to the final sequence of events and "predispose" the accident or incident to occur. By identifying latent cause factors, it is felt that problems with issues such as resources, organizations, processes, infrastructure, equipment and training can be identified and mitigated in order to improve flight safety.

HFACS was introduced in Jan 2004. Therefore this system is still relatively new and it is obvious that flight safety staffs are having difficulties with this system. The main concern is that the analysis of occurrences is still focussed on the active failures at the expense of the latent failures. While the exact reason for this problem has not been determined, feedback indicates that flight safety staff workload is a contributor to this problem. While flight safety staffs are no longer investigating all occurrences, the problem associated with HFACS may have to be resolved by focussing on even fewer occurrences and investigating them more thoroughly. DFS will address this issue in the coming months.

As can be seen from table 9 and 10, the majority of active cause factors fall into three categories: Attention/Memory; Decision Errors and Technique Based errors. Attention/Memory errors occur where the individual omitted a step in a procedure or failed to apply appropriate attention to a given task. Decision errors are based on decisions that are not covered by regulation or procedures and are discretionary on the part of the decision maker. Technique errors involve operation, workmanship or mechanical skills below the level that can reasonably be expected from a person with the proper training and experience. Although an in depth analysis of the data has not been completed, the statistics presented in Graphs 15 and 16 would be expected given the relatively low experience levels, high personnel tempo (for some critical groups) and reduced proficiency levels that the Air Force is currently experiencing. One item of major concern is the number of cause factors related to the routine deviation from orders. This type of cause factor is assigned when rules and regulation transgressions are routine/habitual for the individual concerned and may be condoned by supervisory staff. It has also been termed “rule-bending”. This disturbing number can, in some cases, be attributed to poor supervision which is also an elevated cause factor. DFS will conduct a more in-depth analysis of this issue.

Only a cursory review was conducted of the latent cause factors. As indicated above, it has been assessed that this data is incomplete. However, one cause factor that does stick out is mental states. This type of cause factor is assigned when mental states such as overconfidence, complacency and misplaced motivation affect performance. Anecdotal feedback indicates that a lot of these occurrences are related to personnel with misplaced motivation or a "can do" attitude. In several cases, personnel focussed too much on getting the job done and ended up compromising flight safety. In these latter cases, high pers tempo is a major contributing factor. The other cause factor that merits comment is the level of supervision This cause factor is assigned when supervision is inappropriate, improper or not available at all. Once again, a high pers tempo amongst supervisors is assessed as a major reason for this number.

3.6.2 Fleet Analysis

Table 4 below summarizes the list of noticeable increases in types of occurrence by fleet. These increases have been included when a change was above 50% from a median rate. It must be emphasized that only noticeable trends are indicated for each aircraft type. All major concerns were raised during the Airworthiness Review Board fleet review.

Two common themes were identified fleet wide:

- First, there was an increase in the number of occurrences related to survival and safety equipment in several fleets. This analysis reinforced a concern noted in a number of recent Flight Safety Investigation Reports in which Aviation Life Support Equipment (ALSE) was deficient. DFS staff is actively investigating this issue with the OAA and the TAA staffs.

- Second, several fleets suffered from a high number of occurrences where panels/doors were left unsecured for flight. DFS staff has identified a requirement for further research on this issue.

3.6.3 Fleet Analysis Summary

Table 4 below shows the main trends detected for each aircraft in the CF.

AIRCRAFT TYPE	TREND DETECTED	10-YEAR MEDIAN RATE	2005 RATE	CHANGE FROM 10-YEAR MEDIAN RATE	% CHANGE
CC115 Buffalo	Weapon System (Flare and Pyrotechnics)	4.08	63.3	+59.3	1452.9
CC130 Hercules	Ailerons	1.8	5.2	+3.5	194.4
	Flaps (Mainly Aircrew Handling)	4.7	9.8	+5.2	110.4
	Flight Instrument (Mainly Art./Horizon-Att/Indicator (ADI,ARI,IDAD,HSI,HSD,MAI,GHARS FDI/FD)	1.6	7.9	+6.2	379
	Fuel System	11.7	23.6	+11.9	102.3
	Fuselage / Wing / Empennage (Mainly Vertical Stab Structure & Engine Intake / Nacelle)	9.9	23	+13	131.5
	Hydraulic System (Mainly Line / Tube / Hose)	4.9	11.1	+6.3	129.3
	Survival and Safety Equipments	9.6	15.7	+6.2	64.3
CC142 Dash 8	Survival and Safety Equipments	2.3	15	+12.7	549
	Panel/Door /Open Area	7.7	22.6	+14.9	193.9
CC150 Polaris	Panel/Door /Open Area	11.6	18.6	+7	60
	Fuselage / Wing / Empennage	4.5	14.4	+9.9	219.2
CF188 Hornet	Engine (Mainly Compressor Stall)	30.1	57.2	+27.1	90.2
CH124A Sea King	Main Rotor / Head / Drive Train (Mainly Helo Rotor)	14.7	39.4	+24.7	167.9
	Other (Mainly Fume in the cockpit)	7.9	23.3	+15.4	195.4
	Panel/Door /Open Area	10.7	23.3	+12.7	118.6
CH146 Griffon	Engine (Mainly Compressor Stall)	9	15.3	+6.3	70
	Furnishing and losse Equipment (Mainly Hoist Winches)	12.7	21.7	+9	71.2

AIRCRAFT TYPE	TREND DETECTED	10-YEAR MEDIAN RATE	2005 RATE	CHANGE FROM 10-YEAR MEDIAN RATE	% CHANGE
	Flight Control (Mainly Pilot Handling Flight Control and Tail Rotor Blade	19.2	46.2	+27	140.8
	Other System (Mainly Mag. Plugs – Chip Detector)	34.3	50.8	+21.5	62.7
CH149 Cormorant	Flight Control (Mainly Tail Rotor Blades / Drives Shaft)[note 1]	24.1	106.8	+82.8	343.7
CP140 Aurora	Electrical System	17.8	35.4	+17.6	98.8
	Panel/Door /Open Area	11.5	24.7	+13.1	113.8
	Pneumatics	11.5	19.3	+7.8	67.5
	Survival and Safety Equipments	7.3	14	+6.6	90.1
CC138 Twin Otter	Undercarriage	3.8	35.7	+31.9	847.6
CT114 Tutor	Engine[note 2]	2.6	10.7	+8.1	316.7
	Fuselage/ Wing / Empennages [note 2]	15.5	32.1	+16.6	106.8
	Undercarriage [note 2]	17.6	37.5	+19.8	112.7
CT155 Hawk	Undercarriage (Mainly Aircrew Handling)[note 3]	16.1	29.9	+13.7	85.1
	Panel/Door /Open Area [note 3]	6.5	16.8	+10.2	156.7
	Survival and Safety Equipments [note 3]	6.2	10.2	+4	64
	Flaps (Mainly Aircrew Handling) [note 3]	2.1	9.5	+7.4	356.9

Table 04: Trend Analysis on Type of Occurrences

Notes
1. Cormorant data analysis since years 2002
2. Tutor data analysis since years 2001 (mainly Snowbird ops)
3. Hawk data analysis since year 2000

4. DEFINITIONS

4.1 AIRCRAFT FAMILIES AND CLASSIFICATION CODE

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

FAMILY	CODE	DESCRIPTION
Fighters	CF188	CF18 Hornet
Helicopters	CH124A	Sea King
	CH139	Jet Ranger Bell 206B
	CH146	Griffon
	CH149	Cormorant
Non CF	CATS	Cats
	NONCF	Non CF Aircraft (ALL TYPES)
Others	HAC	Chamber
	NIL	No Aircraft Iinvolved
Patrol	CP140	Aurora
Trainers	CT102	Astra
	CT114	Tutor
	CT145	King Air

FAMILY	CODE	DESCRIPTION
	CT146	Outlaw
	CT155	Hawk
	CT156	Harvard II
Transport	CC115	Buffalo
	CC130	Hercules
	CC138	Twin Otter
	CC142	Dash-8
	CC144	Challenger
	CC150	Polaris (Airbus 310)
UAV	CU161	UAV Sperwer
	CU162	Vindicator
	CU163	UAV Alatair
	CU167	UAV Silver Fox
	CU168	UAV Skylark

Table 05: Aircraft Families

4.2 TERMINOLOGY

The following terminology are condensed extracts from Flight Safety for the Canadian Forces (A-GA-135-000). Essentially, an air accident or air incident occurs between the time the aircraft is started with the intent for flight and the time it is shut down; at any other time the event would be either a ground accident or incident.

4.2.1 Occurrence

The non-specific term occurrence refers to an air or ground flight safety event. An occurrence can be defined as either an accident or an incident dependent upon the assigned category.

4.2.2 Damage Category

Damage to an aircraft is said to have occurred when the aircraft, or any portion thereof, is lost or requires repairs or replacement as a result of unusual forces. eg. Collision, impact, explosion, fire, rupture, overstress, upset, wilful damage, sabotage, or vandalism. This does not include faults that progressively develop as a result of normal flight stresses, eg., repeated applications of loads at or below the design operating limits of the aircraft which in long term result in fatigue failure. Such failures which may be beyond unit resources to repair, or may require replacement of major components, may be classified as progressive wear if the equipment has not been misused or subjected to unusual forces as indicated above. Accordingly, such failures will not be classed as damage but normal wear resulting from prolonged service use. Additional damage which may result from such failures must, however, be classified appropriately. The routine type of system or component unserviceability is not considered to be damage, and need not to be reported unless the originator feels that it has accident potential. The categories of aircraft occurrences reflect the degree of damage as follow:

- ‘A’ Category: The aircraft is destroyed, declared missing or damage beyond

economic repair.

- ‘B’ Category: The aircraft has sustained damage to major components beyond normal second-level maintenance capability and would normally required to be shipped to a 3rd line repair faculty. The overall structure damage is assessed as within economical repair.

- ‘C’ Category: The aircraft must be flown to a contractor or depot-level facilities for repairs; repairs are carried out by a mobile repair party; or a major component has to be replaced

- ‘D’ Category: Damage to any component that can be repaired within field-level resources.

- ‘E’ Category: No aircraft damage, but accident potential exists.

4.2.3 Accident

An event in which the aircraft or person is missing, where there is an A, B or C category aircraft damage, or a person received fatal or serious injury. An accident involving more than one aircraft, is counted as one accident.

4.2.4 Incident

An event where there is a category ‘’D’’ damage or a person received a minor injury; or E category where there is a risk of injury or accident potential, but no aircraft damage. An incident involving more than one aircraft is counted as one incident.

4.2.5 Rate

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

4.2.6 Cause Factors

Any event, condition or circumstances, the presences or absence of which, within reason, increased the likelihood of the occurrence. Cause assessments constitute the basis for the creation and application of preventives measures. Listed below are the definitions for the six cause factors that are assigned to aviation occurrences in the Canadian Forces.

- Personnel: Acts of omission or commission by those responsible in any way for the aircraft operations, which cause an accident or incident. Personnel factors include the individual e.g. pilot, technician, manager, or supervisor.

- Materiel: Materiel failures include failure of aircraft components and any facility related to flight, which has a bearing on the accident or incident. An example of a related facility materiel failure would be a situation where the aircraft is on a final PAR approach and the controller’s equipment fails.

- Environment: Included in this category are such hazards as birds and weather which exists in the aircraft operation environment. This factor is assigned only if all reasonable precautions have been taken and applied to a condition that is beyond human control within the present state of the art.

- Operational: This cause factor is used when an accident or incident occurs as a result of a specific search and rescue flight or during commitments related to the preservation of national security as defined by the B-GA-100. When this cause factor is assigned it must be recommended by the Commander 1 Canadian Air Division and approved by the Chief of the Air Staff.

- Unidentified FOD: This cause factor is used when aircraft damage results from a foreign object that cannot be identified or the source determined.

- Undetermined: This cause factor is applied to occurrences when the evidence available is insufficient to permit a reasonable determination of the cause; however, probable causes are normally assigned so that preventive measures can be implemented.

4.2.7 Human Factors Analysis and Classification System (HFACS)

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

4.2.8 Preventives Measures

Preventives measures and recommendations issued from accident investigation report are indicated for completed investigation.

5. STATISTICAL DETAILS

5.1 FLYING HOURS BY AIRCRAFT TYPE

BY AIRCRAFT TYPE	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TOTAL	177390	170142	162412	150878	135937	133894	138115	132263	131038	124066
CC115	2691	2480	2424	2492	2967	2304	2115	2439	1839	2526
CC130	27970	23412	22036	21556	20360	17656	17067	14833	16422	15248
CC142	4466	3930	4183	3499	2735	2259	2300	2328	2446	2660
CC144	3529	3598	3213	2821	2881	2963	3157	2812	2979	2525
CC150	3308	4026	3923	4154	4079	4328	5267	4760	4516	4847
CF188	23258	23871	21519	21536	19052	16620	16872	15089	13425	13818
CH124A	9930	10211	9291	9068	9002	9108	10027	8236	8480	6855
CH139	6967	7547	5877	5602	6121	6527	6666	6070	6371	5024
CH146	13968	24119	25238	23319	22627	20477	21487	21211	21185	21633
CH149	0	0	0	0	0	239	3196	4906	4568	4586
CP140	15245	14207	14126	11619	10342	9021	9633	9684	9640	9317
CT102	0	0	0	0	0	0	0	0	0	0
CT111	1118	3163	3747	4730	3879	4073	3230	2994	4163	3079
CT114	26559	23093	25330	22983	12503	3408	3781	3894	3903	3738
CT145	4805	5091	4300	4108	4274	3708	3951	4771	5079	3271
CT146	0	0	0	0	0	0	0	0	0	38
CT155	0	0	0	0	592	5128	7342	8383	8446	9137
CT156	0	0	0	0	2213	13016	14474	15838	14942	13728
RETIRED FLEET	33576	21394	17205	13391	12310	13059	7550	4015	2634	2036

Table 06: Flying Hours by Aircraft Type

5.2 AIRCRAFT WRITE-OFF 10 YEAR SUMMARY

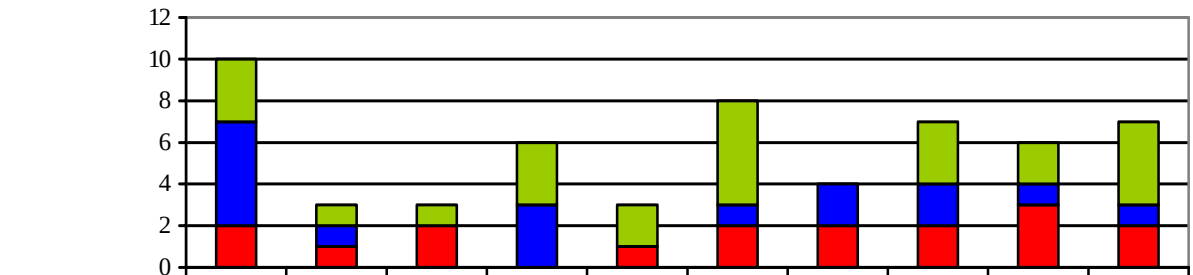
CASE ID	DATE	AIRCRAFT	TAIL #	LOCATION	DESCRIPTION
44172	14-August-1996	CF188	768	Iqualuit, NA	Crash on take-off
93324	13-November-1996	CH146	421	Resolution Island	Water Impact
28522	25-September-1997	CT114	048	Moose Jaw Area, SK	Birdstrike
79005	02-October-1998	CH113	305	Marsoui, QC	In-flight brake-up
28743	10-December-1998	CT114	156	Moose Jaw Training Area	Mid Air
100494	23-June-2000	CH124A	422	At sea	Ditching
104593	21-June-2001	CT114	006	London, ON	Mid Air
106002	10-October-2001	CH139	320	Edmonton, AB	Auto-rotation training
108852	02-July-2002	CH139	308	Southport, MB	Auto-rotation training
109081	18-July-2002	CH146	420	40NM Wesr of Goose Bay, NL	Tail-Rotor Failure
111359	27-February-2003	CH124A	401	At Sea	Crash on take off

CASE ID	DATE	AIRCRAFT	TAIL #	LOCATION	DESCRIPTION
112191	26-May-2003	CF188	732	Cold Lake, AB	Crash
116524	14-May-2004	CT155	202	Moose Jaw, SK	Birdstrike
119527	10-December-2004	CT114	173	Moose Jaw Area, SK	Mid-Air
119527	10-December-2004	CT114	064	Moose Jaw Area, SK	Mid-Air
122639	16-August-2005	CF188	745	Bagotville, QC	Crash
122771	24-August-2005	CT114	120	Thunder bay, ON	Lost of thrust

Table 07: Aircraft Write Off 10-Year Summary

5.3 DAMAGE

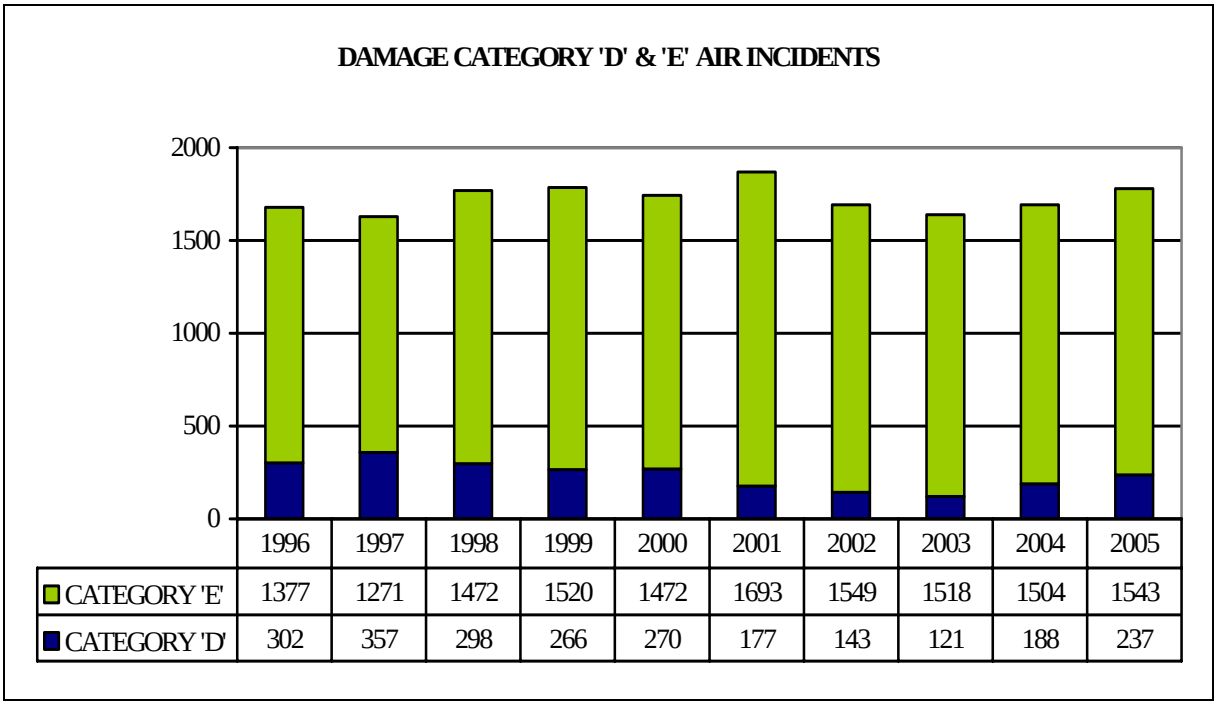
5.3.1 Damage Category ‘A’, ‘B’ and ‘C’ Air Accidents



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CATEGORY 'C'	3	1	1	3	2	5	0	3	2	4
CATEGORY 'B'	5	1	0	3	0	1	2	2	1	1
CATEGORY 'A'	2	1	2	0	1	2	2	2	3	2

Graph 09: Damage Category ‘A’, ‘B’ and ‘C’ Air Accidents

5.3.2 Damage Category ‘D’ and ‘E’ Air Incidents



Graph 10: Damage Category ‘D’ & ‘E’ Air Incidents

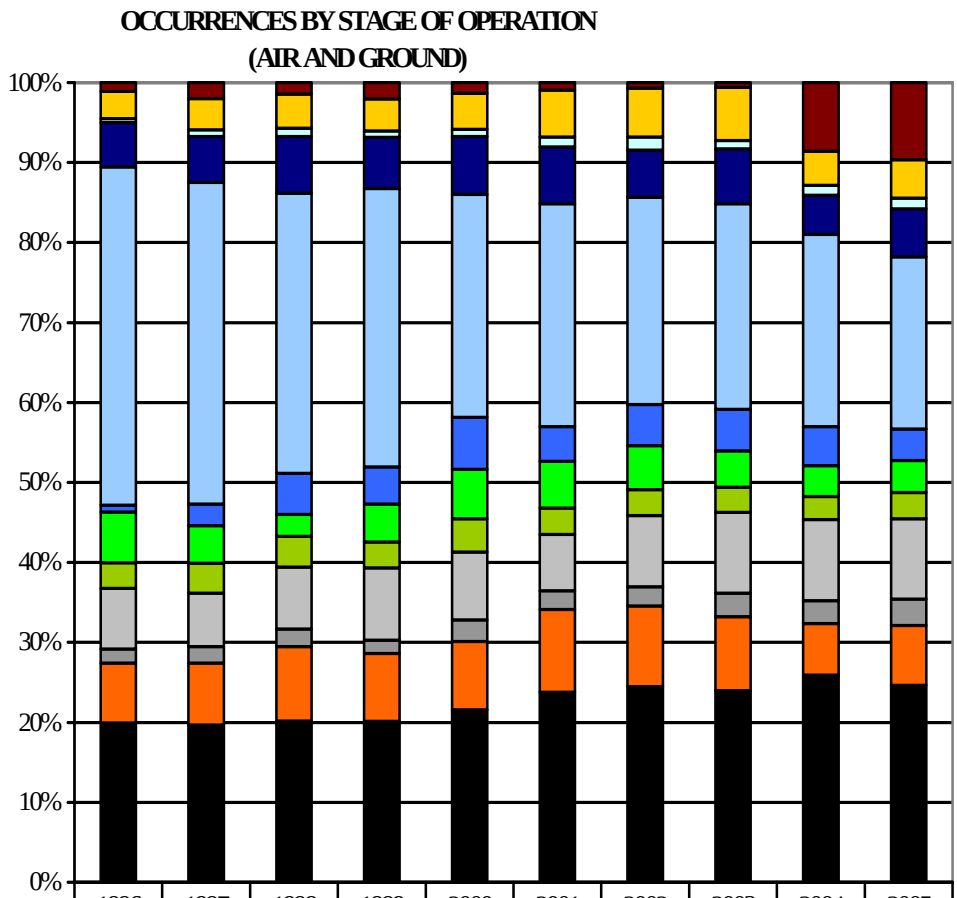
5.3.3 Damage Category ‘A’ to ‘E’ Ground Occurrences

DAMAGE CATEGORY	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CATEGORY ‘A’	0	0	0	0	0	0	0	0	0	0
CATEGORY ‘B’	0	0	0	0	0	0	0	1	0	0
CATEGORY ‘C’	1	0	1	1	0	0	0	0	2	1
CATEGORY ‘D’	296	334	327	252	242	191	181	152	280	324
CATEGORY ‘E’	690	699	630	659	707	879	917	884	793	806

Table 08: Damage Category ‘A’ to ‘E’ Ground Occurrences

5.4 10-YEAR ANALYSIS OF CAUSE FACTORS

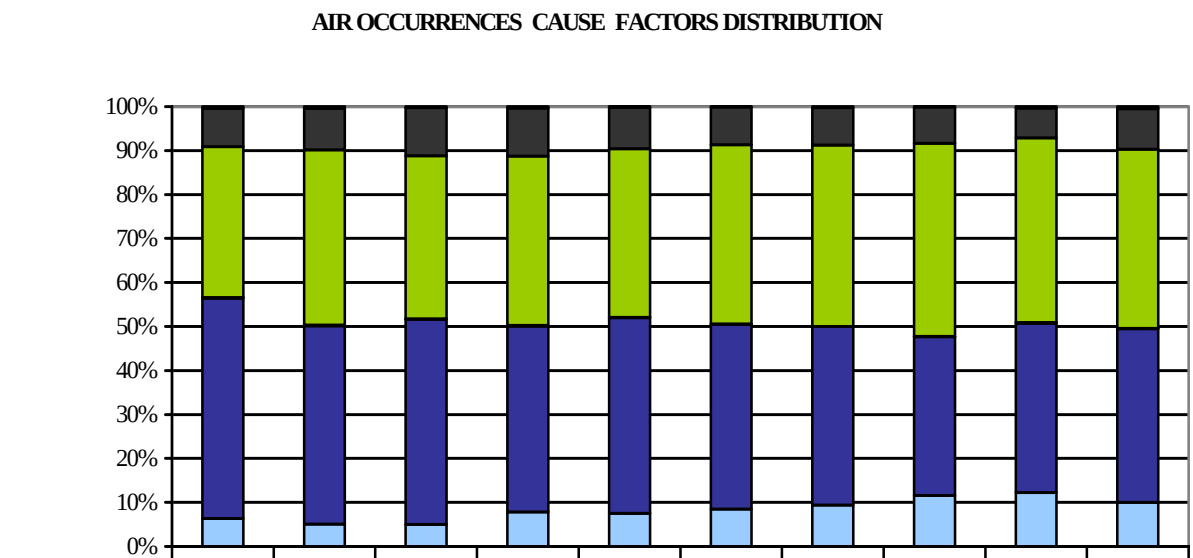
5.4.1 Occurrences by Stage of Operation



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Others	28	52	39	60	40	30	21	17	268	311
Landing	88	102	113	118	135	186	186	195	133	156
Go Around	13	22	28	24	28	40	49	30	38	43
Approach	143	150	191	189	218	227	180	200	154	194
Enroute	1092	1049	937	1028	837	887	788	752	750	696
Climb-Out	22	70	138	137	196	139	156	152	152	126
Take-Off	164	123	73	139	186	186	167	132	120	130
Taxi	82	97	104	96	125	106	99	93	91	106
Ground Running	196	175	207	268	254	224	270	295	317	324
Load/Unload / Weapon Handling	45	53	59	48	81	75	72	86	88	107
Parked and Towing	194	202	248	251	257	330	307	269	202	243
Maintenance	514	514	541	594	649	757	744	701	809	795

Graph 11: Occurrences by Stage of Operation – Air and Ground

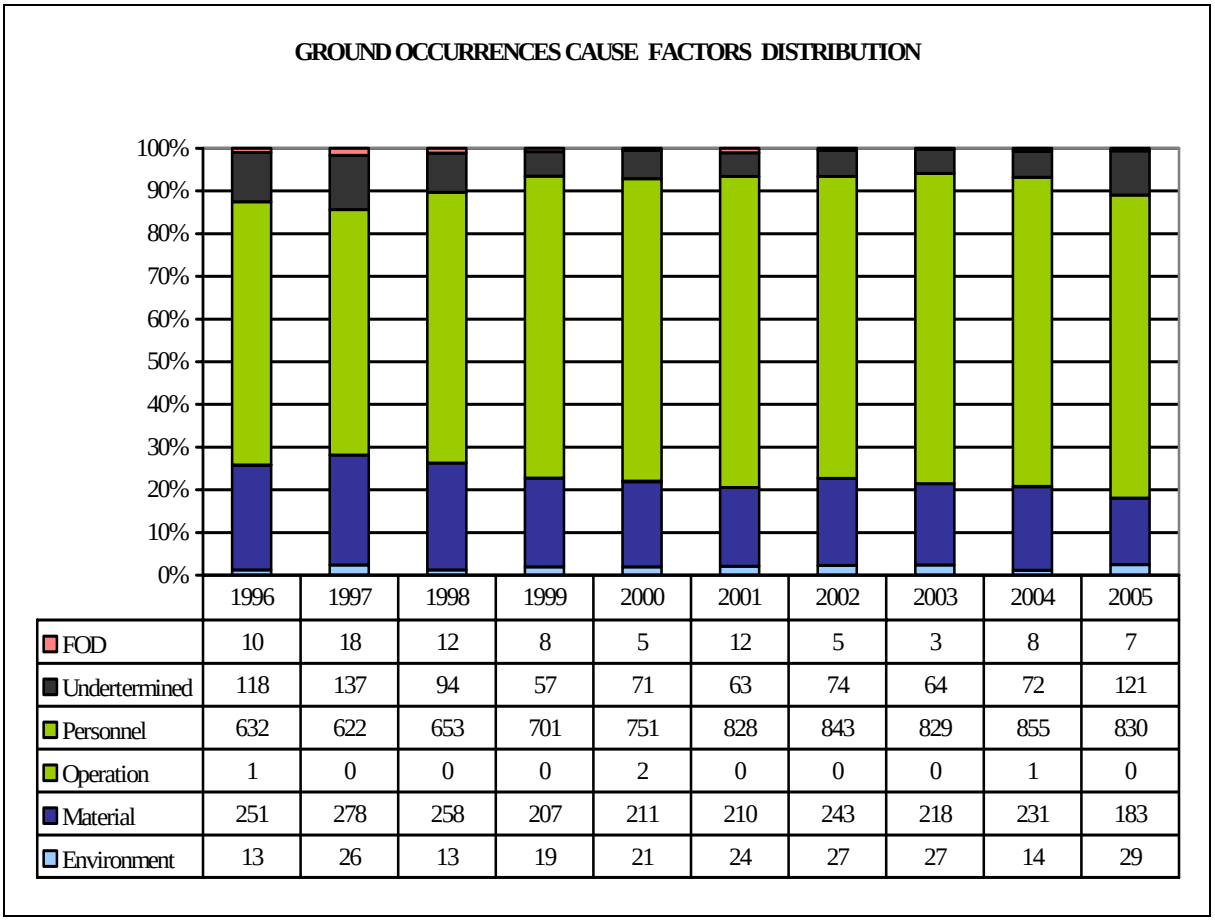
5.4.2 Air Occurrences Cause Factors Distribution



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FOD	7	7	5	7	3	1	5	2	6	10
Undertermined	147	160	198	214	192	182	165	156	131	177
Personnel	579	675	674	754	777	855	798	831	809	788
Operational	4	2	2	3	1	2	0	1	2	1
Materiel	846	765	849	829	902	883	784	684	742	763
Environement	107	86	91	153	153	179	183	219	236	194

Graph 12: Air Occurrences Cause Factors Distribution

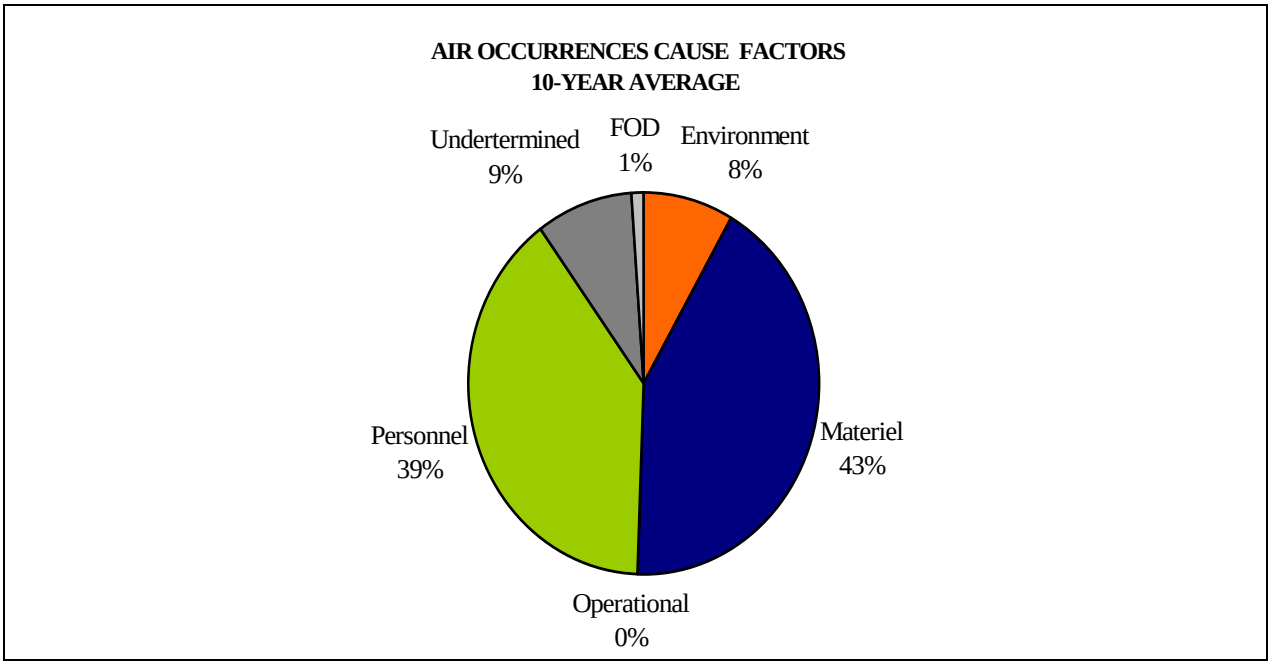
5.4.3 Ground Occurrences Cause Factors Distribution



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
FOD	10	18	12	8	5	12	5	3	8	7
Undertermined	118	137	94	57	71	63	74	64	72	121
Personnel	632	622	653	701	751	828	843	829	855	830
Operation	1	0	0	0	2	0	0	0	1	0
Material	251	278	258	207	211	210	243	218	231	183
Environment	13	26	13	19	21	24	27	27	14	29

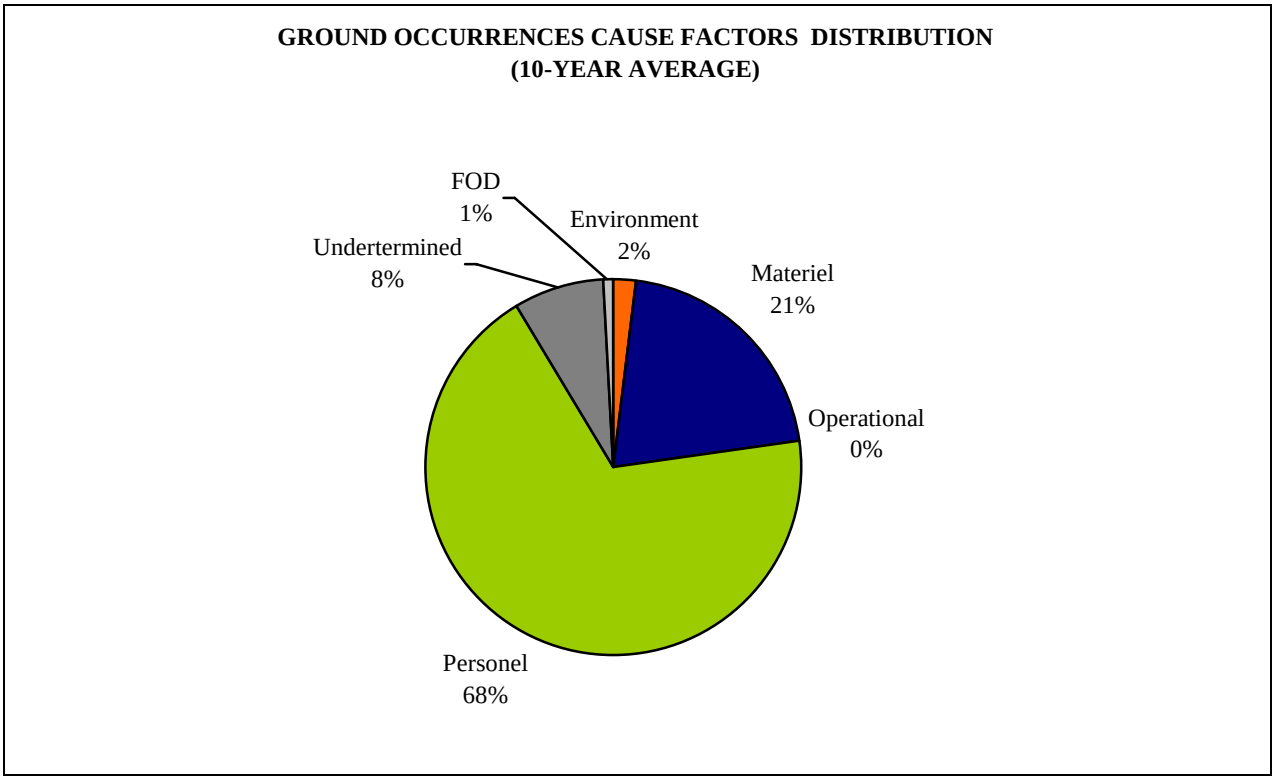
Graph 13: Ground Occurrences Cause Factors Distribution

5.4.4 Air Occurrences Cause Factors 10-year Average



Graph 14: Air Occurrences Cause Factor Distribution 10-year Average

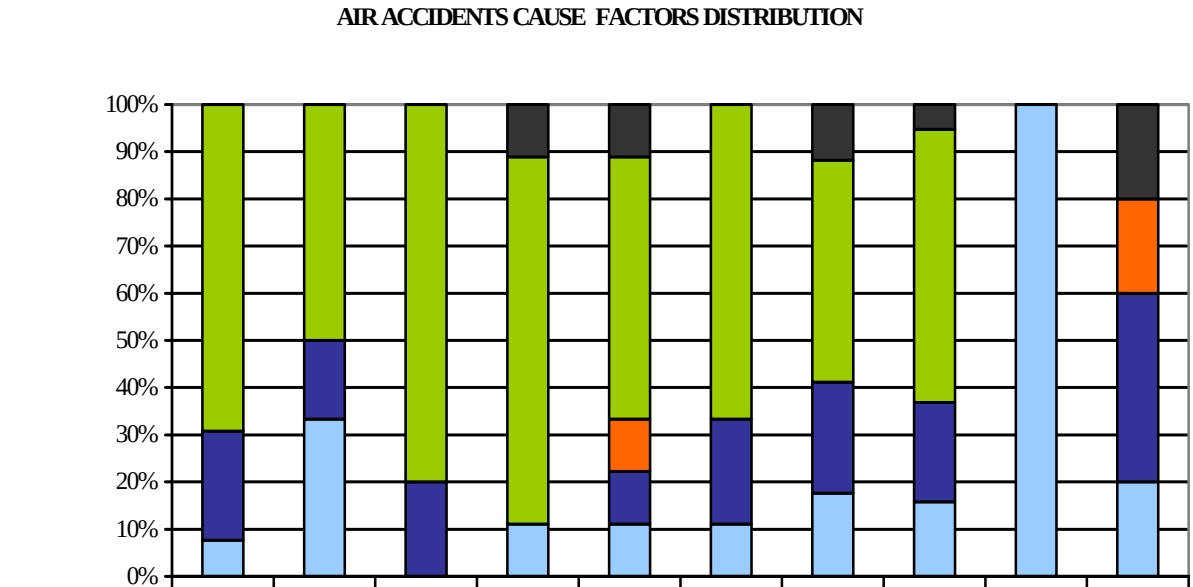
5.4.5 Ground Occurrences Cause Factors Distribution 10-year Average



Graph 15: Ground Occurrences Cause Factor Distribution 10-year Average

5.4.6 Air Accidents Cause Factors Distribution

Graph 16 provides cause factors information for completed investigation. It should be noted that cause factors identification for the year 2004 and 2005 are not fully completed since several investigation are still ongoing for those years.



	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Undertermined	0	0	0	1	1	0	2	1	0	1
Personnel	9	3	4	7	5	12	8	11	0	0
Operational	0	0	0	0	1	0	0	0	0	1
Materiel	3	1	1	0	1	4	4	4	0	2
Environment	1	2	0	1	1	2	3	3	1	1

Graph 16: Air Accidents Cause Factors Distribution

5.5 HFACS CAUSE FACTORS

5.5.1 Air Occurrences HFACS Cause Factors Breakdown

HFACS CAUSE FACTORS		2004	2005	CHANGE	%
TOTAL ACTIVES FACTORS		**1140**	**1024**	**-116**	**-10%**
Errors	Attention Memory	366	387	21	6%
	Decision Errors	249	161	-88	-35%
	Technique Based Errors	348	339	-9	-3%
	Knowledge of Information	102	66	-36	-35%
	Perceptual Errors	29	30	1	3%
Rule and regulation	Routine	28	13	-15	-54%
	Exceptional	18	28	10	56%
TOTAL LATENT FACTORS		**959**	**867**	**-92**	**-10%**
Conditions of Personnel	Mental State	472	477	5	1%
	Physiological States	12	7	-5	-42%
	Physical Mental Limitation	40	17	-23	-58%
Working Conditions	Equipment	22	18	-4	-18%
	Workspace	13	13	0	0%
	Environment	24	24	0	0%
Practices of Personnel	Resource Management	98	65	-33	-34%
	Personal Readiness	6	9	3	50%
	Qualification	5	5	0	0%
	Training	42	37	-5	-12%
Supervision	Rules and Regulation	8	7	-1	-13%
	Planned Activities	15	22	7	47%
	Problem Correction	23	17	-6	-26%
	Level of Supervision	83	75	-8	-10%
Organisational Influences	Resource management	29	32	3	10%
	Organisational Climate	22	5	-17	-77%
	Organisational Process	45	37	-8	-18%

Table 9: Air Occurrences HFACS Cause Factors Breakdown

5.5.2 Ground Occurrences HFACS Cause Factors Breakdown

HFACS CAUSE FACTORS		2004	2005	CHANGE	%
TOTAL ACTIVES FACTORS		**1089**	**1035**	**-54**	**-5%**
Errors	Attention Memory	406	483	77	19%
	Decision Errors	162	130	-32	-20%
	Technique Based Errors	272	210	-62	-23%
	Knowledges of Information	127	105	-22	-17%
	Perceptual Errors	17	17	0	0%
Rule and regulation	Routine	65	31	-34	-52%
	Exceptional	40	59	19	48%
TOTAL LATENT FACTORS		**904**	**879**	**-25**	**-3%**
Conditions of Personnel	Mental State	316	372	56	18%
	Physiological States	5	5	0	0%
	Physical Mental Limitation	10	9	-1	-10%
Working Conditions	Equipement	25	33	8	32%
	Workspace	26	16	-10	-38%
	Environement	14	11	-3	-21%
Practices of Personnel	Ressource Management	79	56	-23	-29%
	Personal Readiness	5	2	-3	-60%
	Qualification	12	9	-3	-25%
	Training	34	30	-4	-12%
Supervision	Rules and Regulation	17	20	3	18%
	Planned Activities	44	26	-18	-41%
	Problem Correction	22	20	-2	-9%
	Level of Supervision	139	158	19	14%
Organisational Influences	Resource management	53	46	-7	-13%
	Organisational Climate	21	19	-2	-10%
	Organisational Process	82	47	-35	-43%

Table 10: Ground Occurrences HFACS Cause Factors Breakdown