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Department of National Defence Trend and Analysis Report Runway Incursions 2000 – 2004

Directorate of Flight Safety

Canada

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EXECUTIVE SUMMARY

From 1 January 2000 to 31 December 2004, a total of 116 runway incursions were identified in the Flight Safety Information System database. A normal trend fluctuation was noted from 2000 until 2002. A trend started emerging in 2003 and reached a peak level of 43 runway incursions by the end of 2004.

Runway incursions attributed to different types of errors showed a consistent distribution and fluctuation from the beginning of the period until the end of the period with the exception of runway incursions Vehicle/Pedestrian Deviations which showed a rising trend in 2003, the latter continuing into 2004. This demonstrates that VPDs are the main cause of the increasing trend in runway incursions.

A vehicle or a pedestrian was involved in two-thirds of all runway incursions (66%), and an aircraft operator was implicated for almost one-third (32%) of the runway incursions, divided equally between military pilots and civilian pilots. Wildlife accounted for the remaining 2%.

Considering the slight decrease in movements at the airfields assessed and the direct correlation between traffic volume and runway incursions, the latter should have flattened or shown a slight decrease throughout the period. This was observed for Pilot Deviation occurrences and Operational Irregularities but not for Vehicle/Pedestrian Deviations; on the contrary, Vehicle/Pedestrian Deviations increased noticeably in 2004.

Interestingly, this finding contrasts with the Transport Canada and the Federal Aviation Administration findings where both organizations indicated that Pilot Deviations generally accounted for the majority of runway incursions.

The analysis of active and latent human factors contributing to the Vehicle/Pedestrian Deviations pointed to a lack of training which could be linked to the level of supervision or lack thereof and/or to resource management.

It is believed that implementing corrective measures targeted at supervisors and resource managers would reverse this trend. Particular attention should be paid to the training of operators, as well as a thorough review of airport related procedure tools and safeguards, as applicable.

Although no runway incursions have resulted in an accident, the number of Vehicle/Pedestrian Deviations will likely continue to rise and may result in a more serious outcome if no corrective measures are taken.

RUNWAY INCURSIONS TREND ANALYSIS REPORT

1. BACKGROUND

In October 2004, DFS staff identified an upward trend in runway incursions (RIs) during a routine manual review of past occurrences in the Flight Safety Information System (FSIS) database[1]. This trend was the subject of a DFS Flight Safety Advisory in November 2004[2].

2. INTRODUCTION

RIs are grouped within much larger list of concerns for aviation safety such as controlled flight into terrain (CFIT), loss-of-control accidents, landing-and-approach accidents and human factors issues. According to NASA[3], close calls between aircraft, other planes, ground vehicles and hazards have grown steadily and represent a concern for aviation safety specialists.

3. AIM

The aim of this trend analysis report is to provide a detailed analysis of RIs at DND airports from the period 2000 to 2004.

4. REFERENCES DOCUMENTS

Many reference documents were reviewed in the preparation of this analysis. A summary of the content and findings of these reports can be found at Annex A.

5. METHODOLOGY

The National Civil Aviation Safety Committee of Transport Canada (TC) developed the methodology and metrics used in the preparation of this report[4]. Further, the CF Human Factor Analysis and Classification System (HFACS) was applied and proved extremely useful for finding active and latent causes of the RIs[5].

The incursion rate was derived from movement data that was provided to DFS by 1 Canadian Air Division A3 Operations for the airports or heliports of Bagotville, Borden, Cold Lake, Comox, Edmonton, Gagetown, Goose Bay, Greenwood, Halifax – Shearwater, Moose Jaw, Petawawa, Trenton and Valcartier. The rate of occurrences was calculated on the frequency of events per 10,000 movements, e.g. take-offs or landing.

6. DEFINITIONS

All definitions are from TC except the RI-Other which comes from ADREP 2000 Taxonomy of the OACI [6]. It is recommended that these definitions be adopted by

DND (see recommendation 10.2.1)

6.1 RUNWAY INCURSION (RI)

An RI is defined as ”any occurrence at an airport involving the unauthorized or unplanned presence of an aircraft, vehicle or person on the protected area of a surface designated for aircraft landing or departure.”[7] [8]

6.2 TYPE OF DEVIATION

6.2.1 Operational Irregularity (OI). An OI is defined as “an RI that occurs as the result of actions taken by a controller or flight service specialist. Safety may have been jeopardized, or less than the appropriate separation minima may have existed in these cases”.

6.2.2 Pilot Deviation (PD). A PD is defined as “an RI that occurs as the result of actions taken by a pilot. Safety may have been jeopardized, or less than the appropriate separation minima may have existed in these cases”.

6.2.3 Vehicle/Pedestrian Deviation (VPD). A VPD is defined as “an RI that occurs as the result of actions taken by a vehicle’s driver or pedestrian”.

6.2.4 Runway Incursion Other (RI-O). A RI-O is defined as “an RI other than an OI, PD and VPD that occurs as the result of the presence of an object or wildlife on a runway in use, excluding birdstrikes”.

6.3 INCURSION SEVERITY CLASSIFICATION

The severity classification is based on the likelihood of a collision with an aircraft and the level of intervention, as applicable, required to prevent the collision.

6.3.1 Negligible. The occurrence would not have caused a collision with an aircraft or vehicle. No intervention was required to keep the runway clear, e.g. an aircraft or vehicle was near (within 200 feet) but not on the active runway and stopped short of the runway surface without intervention.

6.3.2 Low. The occurrence was unlikely to result in a collision with an aircraft or vehicle. ATS or pilot intervention was required to keep the runway clear, e.g. a vehicle or aircraft was near (within 200 feet) but not on a serviceable runway and stopped short of the runway surface when contacted by ATC.

6.3.3 Medium. The occurrence could have resulted in a collision with an aircraft or vehicle. A vehicle or aircraft was on a serviceable runway without authorization or was cleared onto or across a serviceable runway in error, e.g. an aircraft crossed a serviceable runway without clearance.

6.3.4 High. The occurrence could have resulted in a collision with an aircraft or a vehicle. A vehicle or aircraft was on a serviceable runway without authorization or was cleared by mistake and a real risk of collision existed. This classification normally requires ATS intervention to correct, e.g. two aircraft take off from the same runway at the same time.

6.3.5 Extreme. The occurrence would have resulted in a collision with vehicles and/or aircraft and was prevented only by last minute evasive action by the aircrew and/or vehicle operator(s), e.g. a pilot rejected a take-off to avoid a collision with a vehicle or another aircraft.

6.4 INCURSION RATE

The number of occurrences related to RIs expressed in ten thousand movements, e.g. four (4) runway incursions in 30000 movements results in an occurrence rate of 1.33 occurrences for 10000 thousand take-offs and landings, e.g. 4 X 10,000/30,000 = 1.33.

7. DATA ORIGIN AND FILTERING

7.1 DATA EXTRACTION

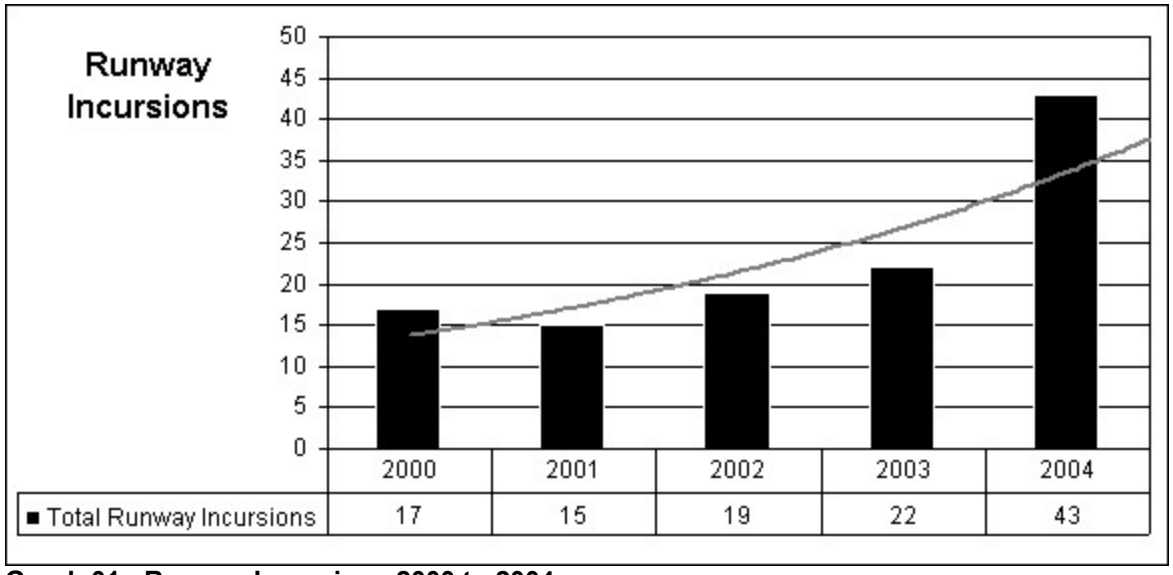
All events were extracted from the FSIS database using ''key words'' search. The occurrences retrieved initially included events that did not meet the definition of an RI such as taxiway incursions, ramp incursions and apron incursions. Further, nine (9) events that had been filed under the events type descriptor ''Near Miss'' [9] were in fact RIs and escaped the first search attempt. This finding shows the importance of promulgating an official event type descriptors list (see recommendation para 10.2.2).

7.2 DATA QUALITY

RIs found in FSIS contained a detailed description on the nature of the RIs and associated cause factors. It was straightforward to manipulate this data into a custom built database and sort them with additional predefined values.

However, it was noted that FSIS lacks the necessary input fields to accurately capture all the complexity factors related to this type of occurrences. e.g. the level of activity at the airport at the time of the occurrence. This data should ideally be captured for future occurrences as it often plays a key role in the cause of the RI. (see recommendation para 10.2.3)

8. TREND ANALYSIS



Graph 01 - Runway Incursions 2000 to 2004

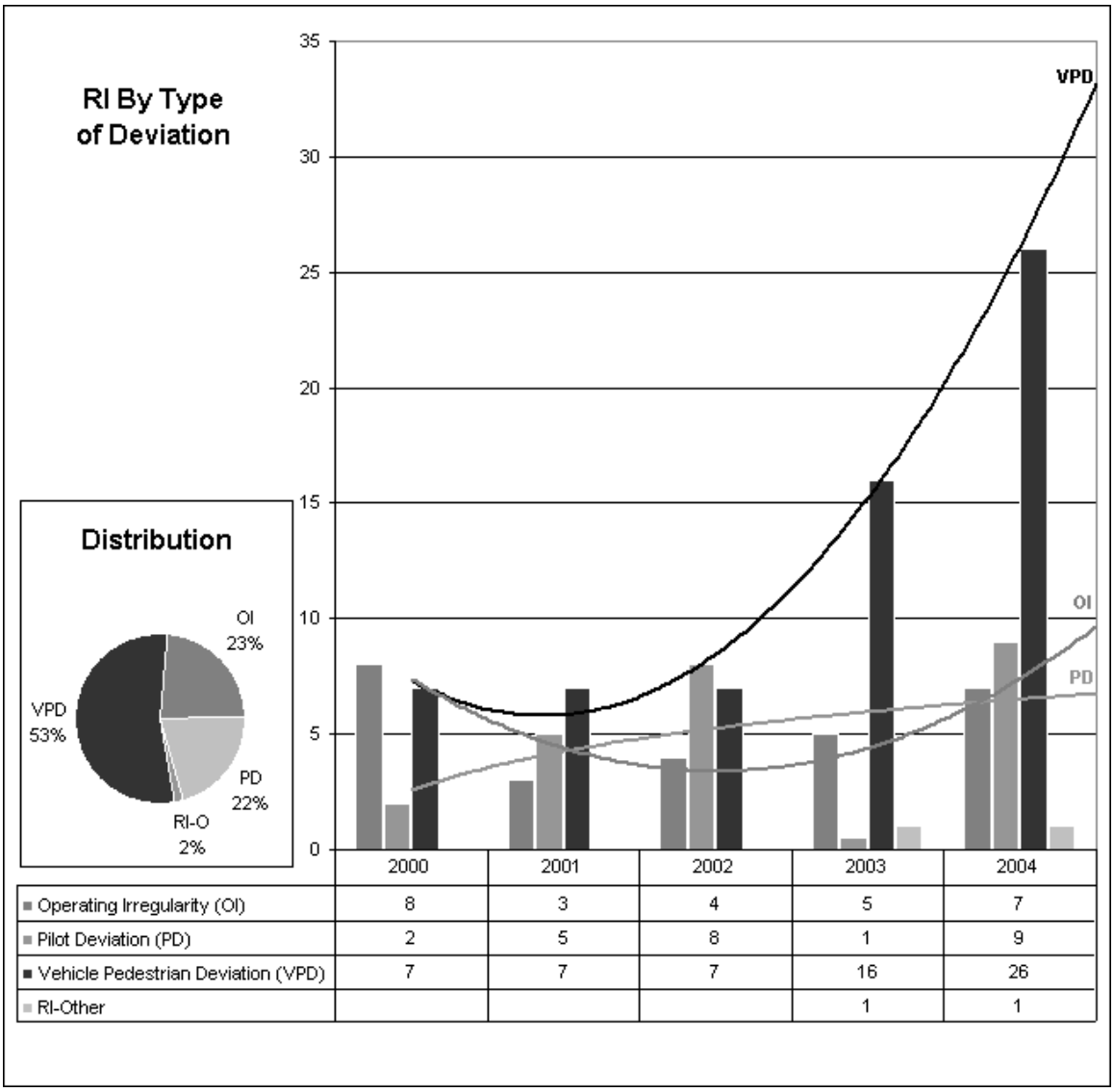
From 1 January 2000 to 31 December 2004, a total of 116 runway incursions (RIs) were identified. As depicted in Graph 01 above, a normal trend fluctuation from 2000 until 2002 followed by a rising trend in 2003 was noted. The peak level of 43 RIs in 2004 represents a 200% increase over the previous years.

9. RI ANALYSIS

To produce charts representing the type of deviation and incursion severity, each report was tagged with a specific attribute based on the report's narrative. The resulting charts present an analysis by Type of deviation and Severity classification as explained in the next subsection.

9.1 ANALYSIS BY TYPE OF DEVIATION

Graph 02 below, displays the numbers of each type of deviation by year. RIs attributed to all the types of errors show a relatively constant distribution and fluctuation over the four years with the exception VPDs, which show a rising trend beginning in 2003 and a continuing into 2004. Therefore, the VPDs are the main cause of the increasing numbers of RIs. This finding contrasts sharply with TC and FAA findings where both organisations indicated that PDs accounted for the majority of RIs.

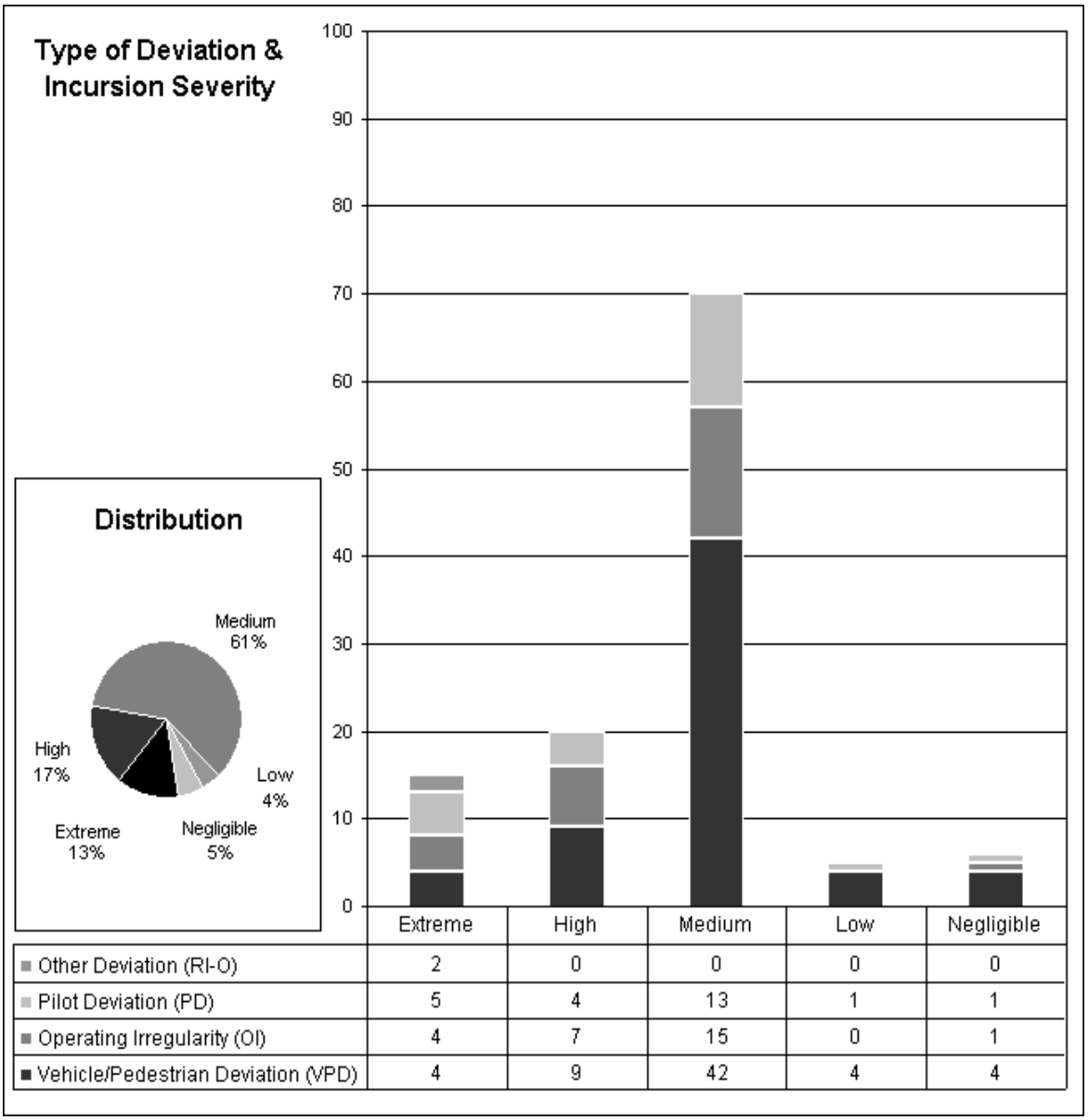


	2000	2001	2002	2003	2004
Operating Irregularity (OI)	8	3	4	5	7
Pilot Deviation (PD)	2	5	8	1	9
Vehicle Pedestrian Deviation (VPD)	7	7	7	16	26
RI-Other				1	1

Graph 02 – Trend by Type of Deviation

9.2 ANALYSIS OF TYPE OF DEVIATION AND SEVERITY CLASSIFICATION

Graph 03 below outlines the breakdown of VPDs, PDs and OIs according to the Severity classification. RIs having a severity rating of MEDIUM account for the majority of the occurrences reported with most VPDs falling in this category. The distribution of VPDs, PDs and OIs becomes evenly distributed for RIs having a severity rating higher than MEDIUM as the severity increases. Interestingly, most RIs represent a serious risk to aviation with 90% of the RIs having a severity classification of medium and higher. This indicates that most RIs have the potential for serious consequences.



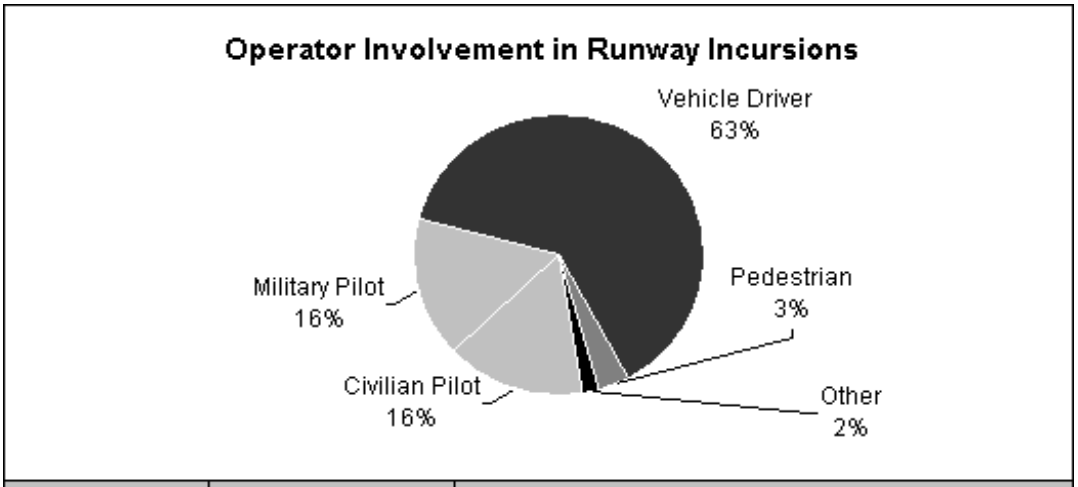
	Extreme	High	Medium	Low	Negligible
Other Deviation (RI-O)	2	0	0	0	0
Pilot Deviation (PD)	5	4	13	1	1
Operating Irregularity (OI)	4	7	15	0	1
Vehicle/Pedestrian Deviation (VPD)	4	9	42	4	4

Graph 03 - Type of Deviation and Incursion Severity

9.3 ANALYSIS BY OPERATORS INVOLVEMENT

An RI involving a vehicle does not always result in a VPD; therefore using only the Type of deviation for the analysis could be misleading. For example, when a vehicle is cleared in error onto an active runway just prior to the issuance of a landing clearance to an aircraft for the same runway, the RI will be caused by the vehicle but be attributed as an OI rather than a VPD.

Graph 04 below breaks down the operator involvement per type of deviation. Pilots have been involved in 37 RIs but were responsible for 24 of these occurrences with the remainder (13) caused by ATC personnel errors (listed as OI in the graph below). On the other hand, the review of 77 RIs implicating vehicle drivers and pedestrians shows that 63 RIs were caused by the driver of the vehicle / pedestrian with the remainder (14) caused by ATC. This ratio is certainly a cause for concern and points to a serious problem area with the handling of vehicles on airfields.

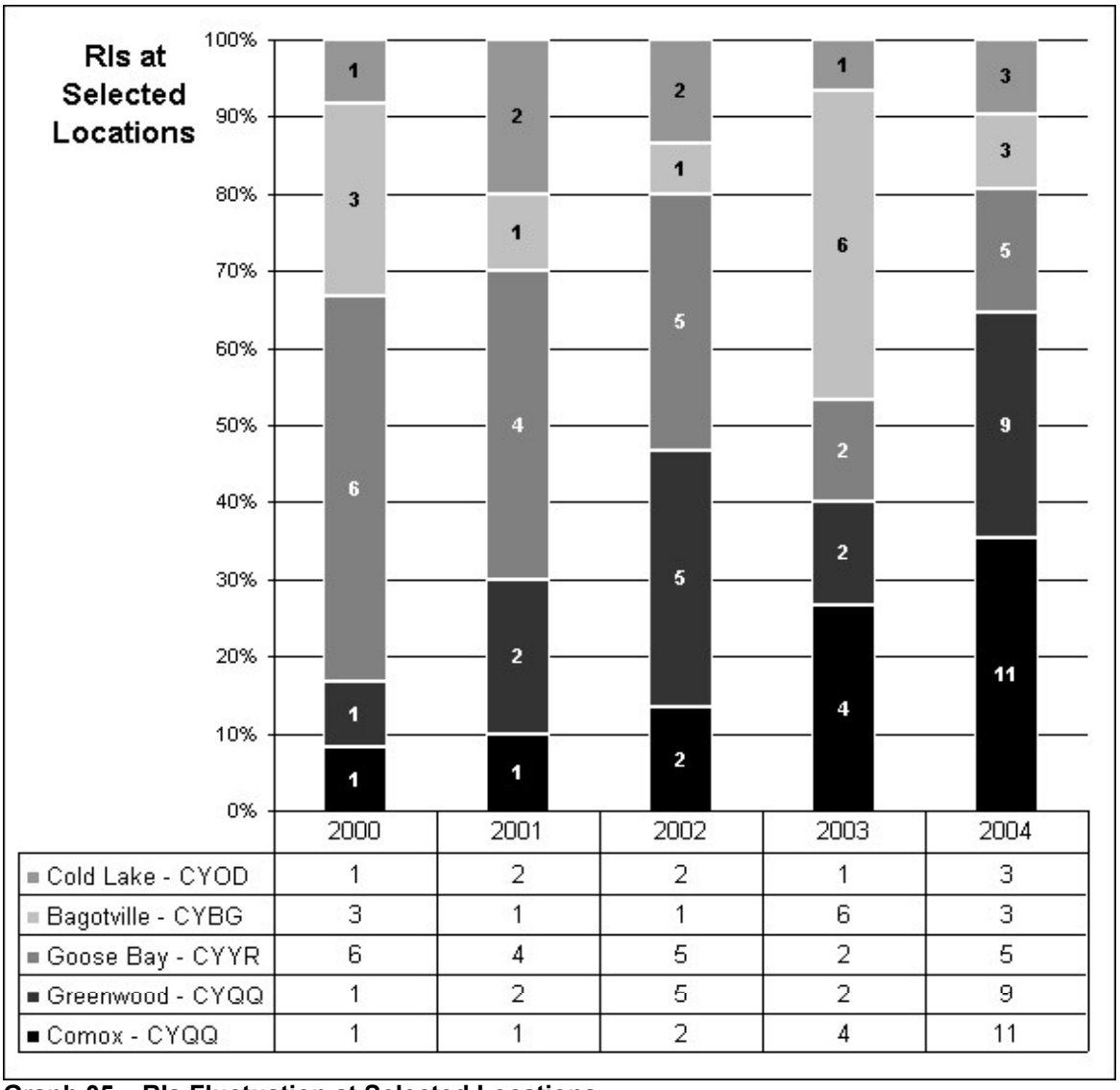


Operator	Involvement		Deviation or Error Type					
			OI		PD		VPD	RI-Other
Military Pilots	19	37	7	13	12	24		
Civilian Pilots	18		6		12			
Vehicles Drivers	73		14				59	
Pedestrians	4						4	
Other	2							2
Total	116		27		24		63	2

Graph 04 – Operator Involvement in RIs

9.4 ANALYSIS AT SELECTED AIRPORT

Graph 05 below shows various fluctuations of RIs in Comox, Bagotville, Goose Bay, Greenwood and Cold Lake. A noticeable increase in RIs was observed at Greenwood and Comox in the latter years of the studied period. A detailed operational analysis, which is beyond the scope of this report, would be required at these Wings to pinpoint the contributing factors and determine the specific corrective measures required.



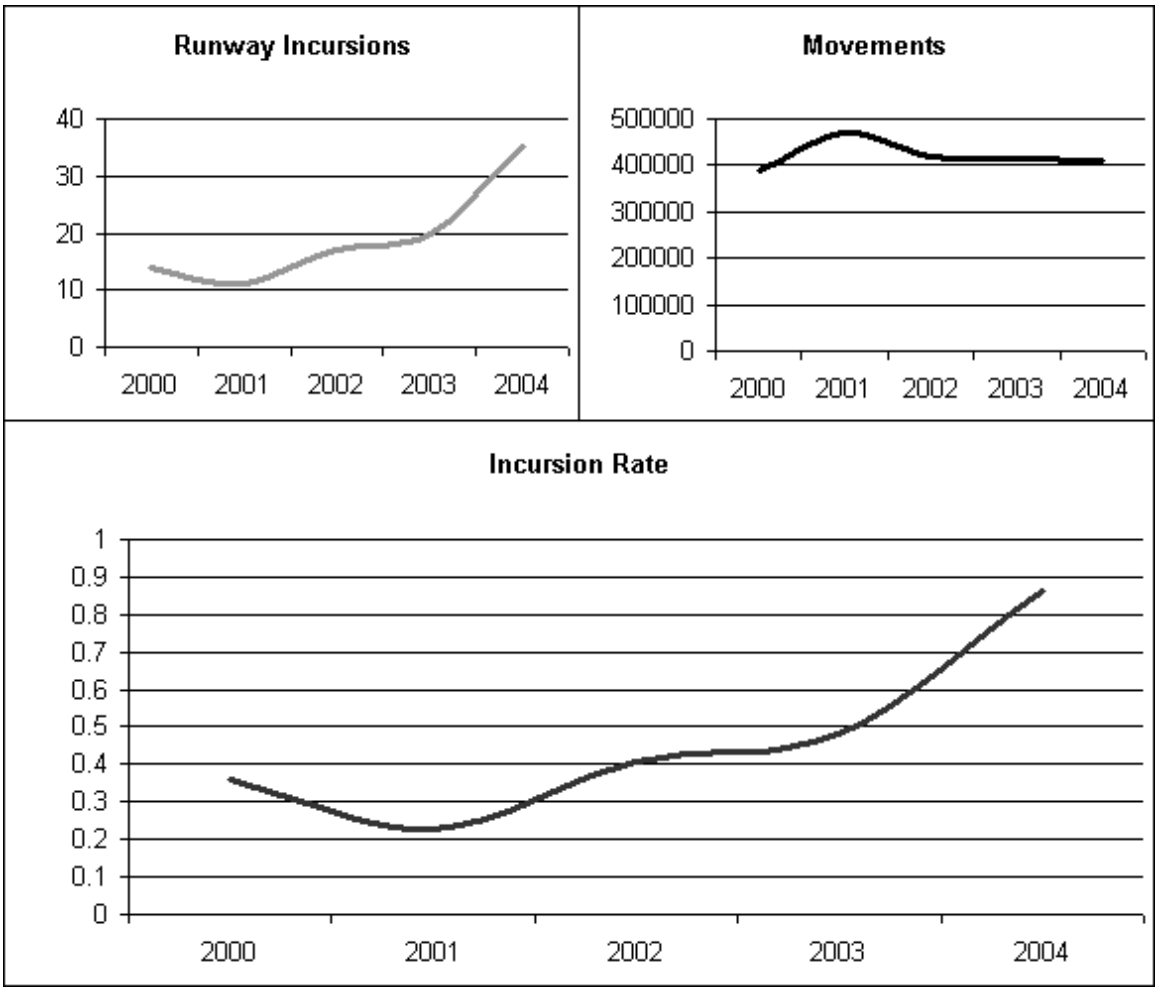
	2000	2001	2002	2003	2004
Cold Lake - CYOD	1	2	2	1	3
Bagotville - CYBG	3	1	1	6	3
Goose Bay - CYYR	6	4	5	2	5
Greenwood - CYQQ	1	2	5	2	9
Comox - CYQQ	1	1	2	4	11

Graph 05 – RIs Fluctuation at Selected Locations

9.5 ANALYSIS BY TRAFFIC VOLUME

TC and the FAA concluded from statistical empirical evidence dating back to 1988 that a relationship between traffic density and RIs has been demonstrated whereby an increase in traffic volume would generate an exponential increase in RIs[10]. For example, a 20% increase in aircraft traffic density would result in a 140% increase in runway incursion potential leading to an increase of actual RIs. Based on this assumption, it is expected that RIs would worsen simply as a function of any increase in traffic volume, even if the performance of pilots, controllers, and vehicle operators improves simultaneously.

Therefore, considering the slight decrease in movement data in the CF over the observed period, RIs should have levelled off or decreased slightly. This was not the case as illustrated in Graph 06 below.



Graph 06 – Runway Incursion rate at Selected Airports

9.6 OTHER CONTRIBUTING FACTORS

As indicated in Graph 04 above, 73 of the RIs implicated VPDs. Table 01 below outlines conditions or situations which rendered the probability of an RI by a VPD more likely. These situations are classified as: operation of emergency vehicles or snow removal vehicles, unfamiliarity with the airport, communication difficulties, turnover of ATC personnel and exercise recoveries involving multiple aircraft.

SITUATION	RI EVENTS OBSERVED 2000 - 2004
Operation of Emergency / Snow removal vehicles	9
Unfamiliarity with airport or lost/uncertain of position (Foreign Military, Civilian Contractor)	8
Lack of proper phraseology or lack of proper Communication equipment in vehicle or using other frequency than Ground Frequency.	5
Turn Over of ATC personnel	4
Exercise recovery with multiple aircraft	3
Total	29

Table 01 – Significant situations involving for VPDs

9.7 ANALYSIS BY HUMAN FACTORS

RIs generated 264 cause factors. Graph 07 below provides the breakdown by cause factors. The top active cause factors were:

- Attention/memory errors;
- Decision errors;
- Technique based errors, and;
- Knowledge of information errors.

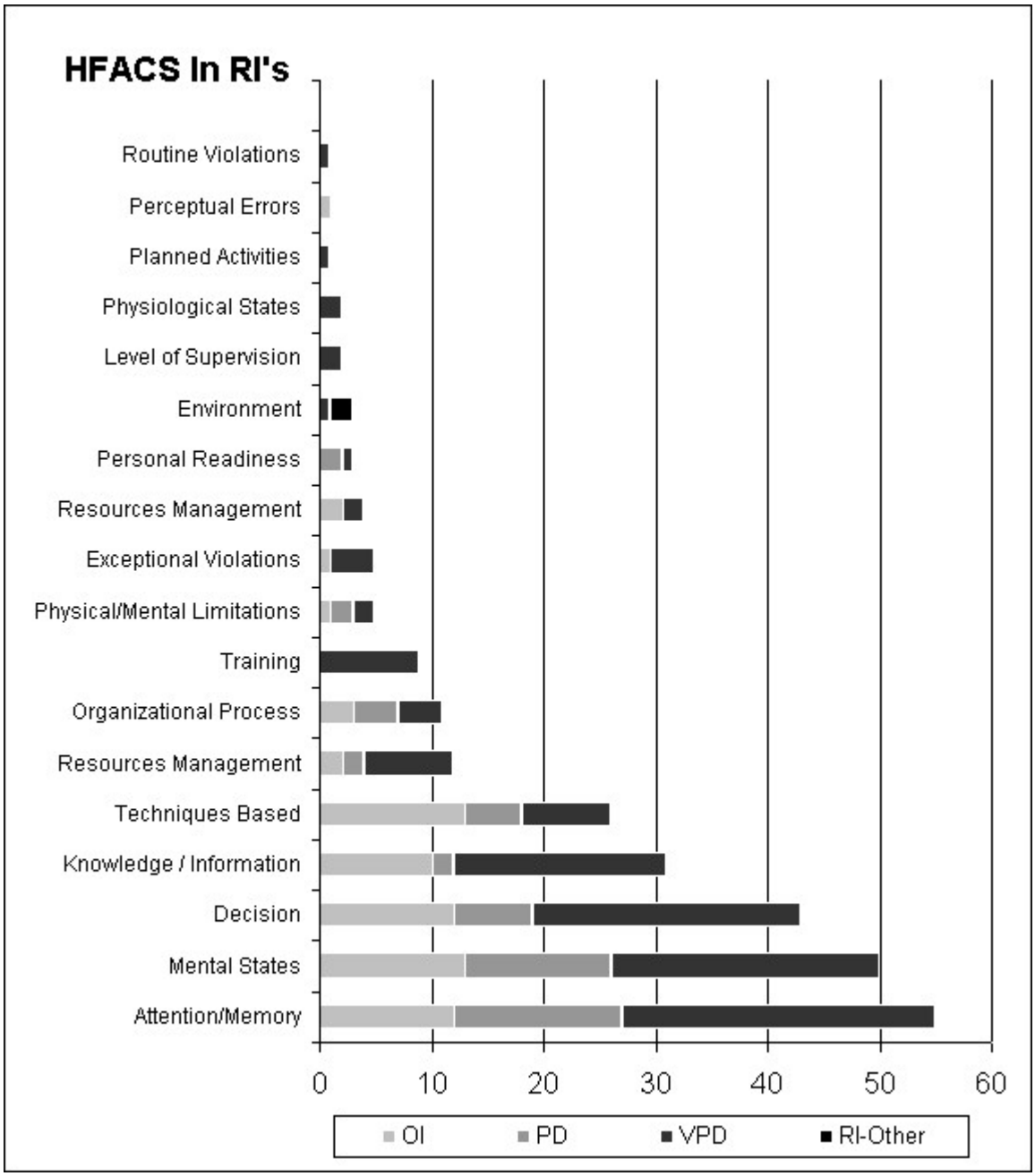
The latent cause factor common to all types of deviation reported was mental state, which ranked second in the listing below. In particular, errors were made in surface navigation, communication, comprehension or when there was a momentary loss of situational awareness.

The distribution of the top five cause factors was consistent between each type of

RI. Notwithstanding, additional cause factors were involved for VPDs, with training shortfalls being unique to the latter.

HFACS defines training as "a precondition present when a person is involved or responsible for a job or task but they are not properly trained or do not have the appropriate skills to safely complete the task." This precondition is linked to the latent cause factor of *level of supervision* or *management* because proper supervision is required to ensure tasked personnel are appropriately skilled and/or the organization is required to provide appropriate training for personnel involved with flight operations. Reporting level of supervision, as a cause factor, might have been overlooked since it was identified in only two RIs while training was causal for at least eight VPDs.

The conclusion reached by this analysis is that Wing staffs should focus on VPD related incursions at DND airports. Furthermore, correctives measure designed to address the *level of supervision* and *training* should produce a positive effect in reversing this trend.



Graph 07 – HFACS Analysis

10. CONCLUSION

10.1 OBSERVATIONS

This analysis concluded that RIs have increased dramatically over the past two years. The main reason for this increase is VPD type RIs. While the detailed corrective measures will have to be developed by each Wing, the following general observations may be of assistance in developing these measures

The increased trend in RIs could be reversed by implementing corrective measures to locally address *training* and *level of supervision* issues in addition to enforcing current safeguards, devices and methods already in place at DND airports.

Specific measures that might assist in resolving this problem are as follows:

10.1.1 The formation of an RI Working Group comprised of one member of each group that regularly operates on the aerodrome manoeuvring area. The objective of this Working Group would be to identify potential hazards and to recommend ways in which these hazards could be mitigated;

10.1.2 The development and enforcement of specific training and currency standards for vehicle operators who drive on the airfield.

10.1.3 The importance of using standard radio phraseology be stressed and closely monitored;

10.1.4 The regular monitoring and reinforcement of standard frequency monitoring[11];

10.1.5 The development and implementation of a ‘’Lost or uncertain of position procedure’’ for vehicle drivers and pedestrians on the airfield;

10.1.6 The development of a coloured airport diagram that graphically indicates the areas of increased RI risk to all drivers. This diagram should be made standard equipment for all vehicles that operate on the airfield;

10.1.7 The mandatory provision of a locally trained escort to untrained or unfamiliar personnel operating on aerodrome manoeuvring areas; and

10.1.8 The visibility and positioning of all airfield signs be regularly monitored and, if necessary, upgraded.

10.2 FSIS RECOMMENDATIONS

The following recommendations applicable to FSIS would enhance the tracking of RIs. It is recommended that:

10.2.1 DFS adopt the TC definitions of RI, Severity Classification, and Type of error in order to provide standard metrics for capturing this type of occurrence.

10.2.2 DFS research and publish an event type descriptor reference guide to standardize the capture of data and/or the specific keyword usage.

10.2.3 DFS amend FSIS input fields to capture RI information as per Annex B. In the meantime, FS investigators should indicate this information in the narrative portion of the occurrence report when dealing with a RI situation.

10.2.4 DFS implement additional computerized analytical tools in FSIS to provide timely trend detection capability for DFS.

10.3 CONCLUDING REMARKS

This report highlights the increasing trend in RIs at DND locations. This report indicates that RIs are rarely the result of a single contributory factor. Pilots, ATC personnel, vehicle drivers and pedestrians all contributed to these incidents. However, the report also identified the increasing trend of VPD type of RIs. The analysis of this trend further revealed that supervision and training were the major latent cause factors for this problem.

It is recommended that Wings focus on improving the level of supervision of airfield vehicle drivers and pedestrians. In addition, Wings should review airfield vehicle driver training practices and standards to ensure that this training is providing the expected results. A number of recommendations have also been developed to help the flight safety program better track this problem.

Finally, it was concluded that, in the absence of corrective measures, the level of VPD related incidents will likely continue to rise and may result in a serious outcome.

ANNEX A - REFERENCE DOCUMENTS

The list of documentation reviewed for the preparation of this report is as follows:

- *Runway Incursion Trends and Initiatives at Towered Airports in the United States, FY2000 – FY2003 (FAA - Aug, 2004)*. This report outlines three metrics to assess runway safety trends: the frequency of runway incursions, the severity of runway incursions, and the type of incidents. Occurrence frequency is reported in rate per millions operations (Movement). The study concluded:
  - On average, one RI per day took place during the four years period.
  - Overall, there is a downward trend in RI with a level off in 2003. The FAA forecast an increased trend in the next decade.
  - The trends for most severe RIs (Category A & B) decreased by 52% and flattened in 2003.
  - Seven (7) RIs caused a collision during the period with one (1) collision resulting in four fatalities.
  - PD was the most common type of RI (57%).
  - No consistent trend was noted for commercial aircraft.
  - The national distribution of RIs was attributed to PDs (57%), OIs (32%) and VPDs (18%).
  - A general aviation aircraft was involved in 75% of the overall RIs and 66% of the severe RIs with the majority being caused by PD.
- *Transport Canada Sub-Committee on Runway Incursions (SCRI) Final Report (TC – Sep, 2000)*. Metrics used in this report included a definition of RIs, and occurrence severity and severity categories. A Risk-analysis methodology has been developed to express occurrence frequency, occurrence severity and trend information for a given airport. The report concluded that factors contributing to the increase in RIs are traffic volume, capacity-enhancing procedures, airport layouts, complexity, and human performance.
- *Runway Incursion Study at Nav Canada ATS Facilities – (Nav Canada Feb 2001)*. The study concluded that:

All reports related to Air Traffic Services (ATS) present evidence of communication and/or coordination problems in the control tower

- All runway incursions are the result of human performance;
- The majority of RIs at Canadian airports are associated with PDs;
- Average Data for 1999-2000 indicates that RIs are associated respectively with 56% for PDs, 16% for OIs and 28% for VPDs;
- The basis for the increase in RIs is traffic volume, capacity-enhancing procedures, airport layouts and human performance;
- RIs increase exponentially with traffic volume, e.g. a 20% increase in traffic volume represents a 140% increase in runway incursions;
- In the absence of significantly improved safeguards, an increase in the potential for RIs can be expected to be associated with an increase in actual RI events;
- If traffic volume remains the same, the potential for RIs increases when capacity-enhancing procedure are put into operation.

- *ICAO ADREP 2000 Taxonomy (ICAO - 25 Jun, 2005)*. The ADREP 2000 is a classification system that is proposed by the International Civil Aviation Organisation (ICAO) for structuring the data analysis of aviation accidents. This taxonomy provides the ability to derive human factors insight from accident databases.

- *ECCAIRS4 Data Definition Standard - Events (ICAO - 25 Jun, 2005)*. European Co-ordination Centre for Aviation Incident Reporting Systems use a Standardized ICAO Reporting System (Open Source Software), which provides enhanced classification related to general incursions. The classification includes: Runway Incursion, Taxiway Incursion and Apron/Ramp incursion. Each is sub-devised to capture the type of operator e.g. Pilot, driver/equipment, person, animal.

- *European Action Plan for the Prevention of Runway Incursions - Release 1.1, Eurocontrol (Eurocontrol, 2003)*.

- *Airbus – Runway and surface operations briefing notes, preventing runway incursion. Library: http://www.airbus.com/about/safetylibrary.asp BN:http://www.airbus.com/about/safetypdfmainframe.asp?url=/pdf/about/safety/FLT_OPS-RWY_OPS-SEQ01.pdf*

ANNEX B - FSIS RUNWAY INCURSION TEMPLATE

FSIS Runway Incursion Template				
DESCRIPTIVE KEYWORD				
RUNWAY INCURSION (RI)				
NOTE: MEET THE DEFINITION OF RI (AS PERCEIVED BY THE INVESTIGATOR)				
OPERATOR TYPE				
AIRCRAFT	VEHICLE	PEDESTRIAN	OTHER	
GENERAL AVIATION FOREIGN MILITARY DND	MILITARY CIVILIAN	MILITARY CIVILIAN	OBJECT WILDLIFE (EXCLUDING BIRDSTRIKES)	
TYPE OF DEVIATION OR ERROR				
Operational Irregularities OI	Pilot Deviation PD	Vehicle/Pedestrian VPD	RI-Other RI-O	
SEVERITY CLASSIFICATION				
NEGLIGIBLE	LOW	MEDIUM	HIGH	EXTREME
OTHER INFORMATION				
TRAFFIC COMPLEXITY				
LOW	MEDIUM	HIGH	UNKNOWN	
TRAFFIC DENSITY				
LOW	MEDIUM	HIGH	UNKNOWN	
TRAFFIC VARIATION				
INCREASING SLOWLY	INCREASING RAPIDLY	DECREASING SLOWLY	DECREASING RAPIDLY	NO VARIATION
Other contributing factors as per the investigation report (Exercise, Emergency, Construction, Environmental, (Indicate ‘’Night times’’))				

Table 02 - FSIS Runway Incursion Template

ANNEX C – RUNWAY INCURSIONS & MOVEMENTS DATA AT SELECTED AIRPORTS

DND Runway Incursions & Movement Data 2000 - 2004											
Airports	**2000**		**2001**		**2002**		**2003**		**2004**		**Total**
	Runway Incursion	Movements	Runway Incursion	Movements	Runway Incursion	Movements	Runway Incursion	Movements	Runway Incursion	Movements	
Bagotville	3	48470	1	61159	1	46302	6	45284	3	45284	14
Borden	1	6284		7758		6719		6620		7842	1
Cold Lake	1	42066	2	54121	2	57576	1	51449	3	49320	9
Comox	1	84784	1	89223	2	79495	4	79053	11	71058	19
Goose Bay	6	49129	4	51977	5	46302	2	43437	5	42496	22
Greenwood	1	34383	2	32288	5	19369	2	25024	9	28817	19
Halifax Shearwater	1	30200		30387		22286	1	18024		16376	2
Moose Jaw	1	66491	1	114045	1	112816		126807	3	121280	6
Trenton	1	34169		36460	1	35593	4	25106	1	28020	7
Winnipeg	1										1
Debert			1						1		2
Gimly Indus Park									1		1
Kabul									1		1
Keflavik			1								1
Langley			1								1
Mountain View			1				1		1		3
Portage La Prairie					2				2		4
St-Jean									1		1
St-John's							1				1
Yellowknife									1		1
TOTAL	17		15		19		22		43		116

Table 03 - Runway Incursion & Movements Data 2000 – 2004

ANNEX D - DETAILED HFACS ANALYSIS

DND Runway Incursions - HFACS Analysis									TOTAL	OI	PD	WPD
Factors	234	Latent Causes	91	Organizational Influences		13		Resources Management	4	2		2
								Organizational Climate	0			
								Organizational Process	9	1	4	4
				Unsafe Supervision		2		Level of Supervision	1			1
								Planned Activities	1			1
								Problem Correction	0			
								Rules & Regulation	0			
				Preconditions for unsafe acts	76	Conditions of Personnel	52	Mental States	46	13	10	23
								Physiological States	2			2
								Physical/Mental Limitations	4		2	2
						Practices of Personnel	24	Resources Management	12	2	2	8
								Personal Readiness	3		2	1
								Qualifications	0			
								Training	9			9
						Working Conditions	0	Equipment	0			
								Workplace	0			
								Environment	0			
		Active Causes	143	Unsafe Acts or Conditions	143	Errors	137	Decision	41	7	7	24
								Techniques Based	20	8	4	8
								Attention/Memory	47	10	12	25
								Knowledge Information	28	8	2	18
								Perceptual Errors	1	1		
						Rules & Regulations	6	Routine violations	1			1
								Exceptional violations	5	1		4

Table 4: Runway Incursions – HFACS Analysis

ANNEX E - FOOTNOTES

[1] DFS is planning to implement an Automated Trend Monitoring System in the near future.

[2] Reference: E-mail to DFS CAS FS Team sent on Monday November 08, 2004 titled *DFS - Flight Safety Advisory - Increase in aviation safety occurrences involving runway incursions*.

[3] Indicate source

[4] Transport Canada Sub-Committee on Runway Incursions (SCRI) Final Report (TC – Sep, 2000)

[5] In order to do so, human cause factors recorded before the introduction of HFACS on 1 Jan 2004 were converted as best as possible to HFACS using the information contained in each report.

[6] ICAO ADREP 2000 Taxonomy (ICAO - 25 Jun, 2005)

[7] Transport Canada SCRI Sep 2000. Final Report - Sub-Committee on Runway Incursions (TP 13795)

[8] Reference: European Action Plan for the Prevention of Runway Incursions - Release 1.1, Eurocontrol (Eurocontrol, 2003) Eurocontrol/JAA adopted the Transport Canada definition in Nov 2004

[9] In aviation, the keyword NEAR MISS relates to any infringement of standard separation minima in the airways system as recommended by the International Civil Aviation Organization (ICAO). NATO defines NEAR MISS as any circumstances in flight when the degree of separation between two aircraft might constitute a hazardous situation.

[10] Transport Canada SCRI Sep 2000. Final Report - Sub-Committee on Runway Incursions (TP 13795)

[11] At some airports, Nav Canada uses a merit point system for drivers, which has produced some positive results.