CANADIAN FORCES
FLIGHT SAFETY INVESTIGATION REPORT (FSIR)

FINAL REPORT

FILE NUMBER: 1010-C-GFMC (DFS 2-3-3)
DATE OF REPORT: 25 July 2006

AIRCRAFT TYPE: SGS-2-33A C-GFMC
DATE/TIME: 01 2205Z May 2005
LOCATION: Netook Gliding Centre (Olds, Alberta)
CATEGORY: "B" Category Accident

SYNOPSIS

The mission was a winch launch and circuit for two qualified glider pilots. Immediately after becoming airborne, at approximately fifteen feet above ground level (AGL), the aircrew felt a loss of power from the winch. The front-seat pilot manually released the tow cable and lowered the nose of the glider in an attempt to land straight ahead. The glider then over-flew the tow-rope. The winch, which had suffered a momentary power loss, recovered and surged back to normal power, causing the recovery parachute to blossom. The tail-wheel of the glider became entangled in the recovery parachute, and, as the winch surged, it pulled on the tail-wheel causing the glider to rotate 360-degrees about its lateral axis. The glider impacted the ground with right bank, 20-degrees left yaw, and very little forward speed. Both glider occupants were treated for minor injuries and released from a local hospital.

TABLE OF CONTENTS

1. FACTUAL INFORMATION

GENERAL

The Netook Gliding Centre is used to provide familiarization glider flights for several Prairie Region Air Cadet Squadrons. Netook conducts both air-tows, utilizing a Belanca Scout, and winch launches. A winch launch is a method of getting a glider airborne by attaching it to a 4,400 foot cable and pulling it airborne with a winch. Using this method, a glider can typically reach heights of between 800 to 1200 feet AGL. On the day of the occurrence, approximately forty winch launches had been conducted with the occurrence winch prior to the incident flight.

1.1. History of the Flight

The incident flight was scheduled to be one of the last flights of the day. The crew consisted of the Instructor Pilot (rear-seat), and glider pilot (front-seat). The aim of the flight was to provide training for the front-seat pilot. During the occurrence the front-seat pilot, who was a civilian instructor with the air cadets, was at the controls.

The flight began in the normal fashion with the winch accelerating the glider to flying speed. Immediately after becoming airborne, and at approximately fifteen feet above ground level (AGL), the glider experienced a loss of acceleration due to a power loss of the winch. The glider crew released the tow-cable and lowered the nose in an attempt to land straight ahead. As the glider overflew the tow-cable, the winch motor accelerated, and with no load on the cable, the recovery parachute blossomed. The parachute became entangled with the tail wheel of the glider, and, notwithstanding the control column being positioned full forward, the nose of the glider began an abrupt and aggressive increase in pitch. The cable and parachute released from the glider as the glider passed through 90-180 degrees of pitch. The manoeuvre continued until the glider rotated 360-degree about its lateral axis. The glider impacted the ground in a nose low attitude with right bank and 20^{O} left yaw. It bounced forward approximately six feet before coming to rest. Total distance from the commencement of the launch to the final resting place was approximately 135 yards.

1.2. Injuries to Personnel

Table 1: Injuries to Personnel

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor	2	0	0

1.3. Damage to Aircraft

The aircraft initially impacted the ground on the front skid, followed by the tail wheel and right out-rigger. Structural damage was evident throughout the fuselage (Photo 1). The nose skid, tailwheel, and out-rigger all suffered impact damage. The aircraft suffered "B" category damage.

The aircraft has been re-built and is flying again.

1.4. Collateral Damage

Nil.

1.5. Personnel Information

Table 2: Personnel Information

	Instructor Pilot	Pilot	Winch Operator
Rank	2Lt	Civ	Ocdt
Aircrew/Operator Category valid	Yes	Yes	Yes
Currency requirements	Yes	Yes	Yes
Medical Category valid	Yes	Yes	Yes
Total flying time (hours)	70	30	56
Hours on type	70	30	56
Hours last 30 days	3	1	4
Duty time - Day of accident	7.5	7.5	7.5

1.6. Aircraft Information

The Schweizer 2-33A is a conventional two-place tandem, intermediate-training sailplane. Construction is all metal with fabric cover on the fuselage and tail surfaces. The incident aircraft is owned by the Air Cadet League of Canada and maintained to Transport Canada standards. The aircraft was serviceable prior to the accident.

1.6.1. Winch

The winch is an air cadet glider launch winch using a 460 cubic inch gas engine mated through a transmission to a drum cable retrieval system (photo 2). The entire unit is mounted on the back of a 2-ton truck. Routine maintenance is performed by the Netook Gliding Centre, and annual inspections are conducted by an accredited heavy-equipment mechanic.

1.6.2. Tow-Rope

The tow-rope consists of three main sections. The first section is a 4,400 foot long steel cable. This is attached on one end to the winch, and on the other to a drogue parachute. The drogue parachute, which is designed to deploy only after tension has been released from the tow-rope, is used to slow the descent of the cable after it has been released from the glider. The parachute is then attached to a “weak-link”. The weak-link is a length of rope designed to break under a pre-determined stress load in the event the glider cannot release the tow-rope. The weak-link is then attached to the glider. (Photo 3)

1.7. Meteorological Information

Netook does not issue hourly weather reports. However, the area forecast indicates the weather was partly cloudy with a scattered to broken cloud layer between 5,000 and 6,000 feet. Wind was light from the north with a temperature of 5 degrees Celsius and an altimeter setting of 30.40 inches of mercury.

1.8. Aid to Navigation

Nil.

1.9. Communications

Communication between the Launch Control Officer (at launch point), the Retrieve Truck, and the winch operator is via a discreet hand-held radio network. The airfield also utilizes an Aerodrome Traffic Frequency of 123.3 megahertz.

1.10. Aerodrome Information

Netook Gliding Centre is an Alberta Air Cadet League owned airport in south-central Alberta. It is located approximately one hour north of Calgary. The airfield possesses two turf runways. Runway 14/32 is 4400 feet long and 300 feet wide. Runway 01/19 is 3700 feet long and 200 feet wide. (Photo 4)

1.11. Flight Recorders

Nil.

1.12. Wreckage and Impact Information

The glider impacted the ground with very little forward speed. The distance from the initial impact point to the final resting place was approximately six feet. The airframe, which remained intact after the accident, was subsequently towed into a hangar. The winch did not sustain any damage. Both the glider and winch were quarantined until the arrival of the Flight Safety Investigation team.

1.13. Medical

Both pilots egressed the glider on their own and were promptly taken by staff car to the local Emergency Department. Both were examined by the Emergency Physician on duty and released shortly thereafter without any further follow-up requirement. Both experienced minor injuries. No toxicology samples were taken following this accident.

1.14. Fire, Explosives Devices, and Munitions

No fire occurred at the glider impact site or at the winch.

1.15. Survival Aspects

The crash was survivable. The cockpit maintained its survivable volume and was relatively undamaged. The deceleration forces were within the tolerance level of the human body. The front-seat pilot egressed after opening the canopy. There was minor trouble opening the canopy as the bent fuselage caused interference between the leading edge of the left wing and the canopy. The rear-seat pilot egressed through the appropriate rear-seat door located on the aircraft's right side.

1.16. Test and Research Activities

Fuel samples were taken from various points on the winch as well as the winch fuel storage tank. In addition, the fuel filter from the storage tank was removed and sent with the fuel samples to Quality Engineering Test and Establishment (QETE) for analysis.

The winch was formally examined by a qualified winch/heavy-equipment mechanic.

1.17. Organizational and Management Information

1.17.1. Netook Gliding Centre

The Netook Gliding Centre is owned and administered by the Air Cadet League of Canada. Daily operations are conducted by a cadre of Cadet Officers and civilian Instructors. The operational guidance is outlined in the Netook Gliding Centre Standing Orders, and the Netook Gliding Centre Flying Orders. The

Netook Gliding Centre is structured with one Commanding Officer (CO), and two Deputy Commanding Officers (DCOs). The DCO (Tow) is primarily responsible for tow operations while DCO (Winch) is primarily responsible for winch operations.

1.17.2. Command and Control

The normal set-up at Netook includes a Launch Control Officer (LCO), a retrieve driver and a single winch operator. Their duties are as follows:

LCO – direct and ensure the safe and efficient operation of all gliding and gliding support activities on the airfield. This includes co-ordinating and controlling the launches and all ground movements of gliders and tow planes and the recovery of tow planes as well as monitoring the recovery of gliders.

Retrieve Driver – drive the retrieve vehicle during winch operations to retrieve the cable after it has been released from a glider and return it to the launch point for the next glider.

Winch Operator – operate the winch and conduct winch launches.

The LCO clears the launch sequence to begin. The glider pilot is then responsible for verbally and visually signalling the stages of the launch. The signals are repeated by the Retrieve Driver over the radio, with the LCO monitoring the signals. A typical winch launch operation will proceed as follows:

a. With the winch engine running and the glider connected to the winch cable, a "take up slack" signal from the launch point is received. The winch operator will release the drum brake sufficiently to allow a very slow take up of slack until the cable becomes taut;
b. When all participants are ready, an "all out" signal is received. The winch operator will release the brake and power is applied until the proper launch airspeed is obtained. The winch power is adjusted throughout the launch to maintain the proper airspeed or tension for the wind conditions present;
c. During the launch, the glider pilot may find the launch airspeed excessive and signal the reduction to the winch operator by yawing from side-to-side as described under SOPs. The winch operator should carefully reduce power to bring the glider back into its proper speed range. In the event that the glider airspeed drops below safe launch airspeed, the glider will release;
d. As the glider reaches the top of the launch, the power should be reduced to signal the glider pilot to release. After the release occurs, the power is again applied to take up slack and draw the chute away from the glider while keeping the chute inflated. The cable is drawn in under power until the operator is sure that the cable will land in an

appropriate area of the airfield. As the chute approaches the ground, the power may be reduced to allow the chute to slow as it touches the ground; and

e. After the cable contacts the ground, it is picked up and returned to the launch point by a Retrieve Driver.

The Launch Control Officer or Retrieve Driver can abort the take-off at any time by transmitting “Stop Stop Stop” over the radio. The pilot and other personnel present will also give the stop signal if they feel abnormalities in the launch are occurring.

1.18. Additional Information

The glider C-GFMC has been written-off by the insurance company and released to the Air Cadet League. The Air Cadet League of Canada has re-built this aircraft and it is flying with Central Region Air Cadets.

1.19. Useful or Effective Investigation Techniques

Nil.

2. ANALYSIS

2.1. General

This accident was initiated by a momentary power loss of the winch. The investigation therefore focused on both the role of the winch operator and the maintenance of the winch. The pilots of the glider were not assessed as contributing to the accident. Post-crash response by the Cadets and Staff at the Netook Gliding centre was very well handled.

2.2. The Winch

The accident occurred at the end of a normal day of gliding operations during which there had been approximately forty winch launches. Throughout the day, previous winch operators had noted that the idle speed of the winch engine was approximately 100-150 revolutions per minute (RPM). The normal idle RPM should be 700-800 RPM. As well, it was noted that the winch engine occasionally produced black smoke when full power was applied. The first winch operator had noted these abnormalities and had just handed control of the winch to the occurrence winch operator. The first winch operator was in the process of informing the DCO (Winch) of the winch engine abnormalities when the accident occurred. The accident occurred on the second launch by the occurrence winch operator.

The tachometer on this particular winch is located below, and slightly right of the operator's line of sight. In addition to the tachometer, this particular winch has gauges that indicate various parameters such as oil pressure, water temperature, and other temperatures (photo 5). There are no established limitations for these indications. The lack of operating limitations allowed this winch to be used for launching gliders even though it was not operating normally. As well, there are no clear reporting procedures to follow in the event that a winch engine did not operate normally.

2.2.1. Maintenance

Inspection of the winch engine, by a certified heavy equipment mechanic, indicated that it was running at a very rich fuel mixture. Some symptoms of a rich fuel mixture are black smoke during power application, and, a rough running engine caused by fouling of the spark plugs. Both of these symptoms were present throughout the day of the accident. The rich fuel mixture and fouled spark plugs could ultimately lead to power loss.

The investigation determined that a leaking "power valve" caused the rich fuel mixture.

2.2.2. Inspections

The winch must undergo three series of inspections. The first is a 'Daily Inspection' as per the Air Cadet Gliding Program Manual. There is no direction given on who can perform this inspection, although the Winch Launch Operator Course certifies the operator to carry out and authorize daily inspections.

On completion of the 'Daily Inspection' a 'Winch Start Check' is conducted. This check states that the winch must be allowed to warm-up, and all gauges must be operational and in the normal range. However, the 'Winch Start Check' does not specify what the 'normal' range is.

The second inspection is a '100 Hour Inspection'. This inspection must be completed by a person designated by the RCA Ops O and is as follows:

WINCH – 100 HOUR

a. Oil Change
b. New Oil Filter
c. Transmission fluid – condition, cleanliness. Change if required.
d. Differential – Check fluid level.
e. Brakes – Fluid level and condition, leaks.
f. Battery – electrolyte levels, cleanliness and charge.
g. Fan Belt – Tension and condition.
h. Radiator– inspect for leaks, condition and fluid strength. Hoses for condition and security.
i. Exhaust – Check for cracks and condition
j. Fan and Shroud – condition and security
k. Air Filter – Check and replace as necessary
l. Light Lubricant
    (1) Throttle Linkage
    (2) Transmission Linkage
    (3) Brake Lever
    (4) Guillotine
    (5) Rollers and Head
m. Grease drive shaft "U" joints
n. Light and Beacon – Functional and Secure
o. Instruments – Functional, secure and operating within limits

The third inspection is the 'Annual/Seasonal Inspection' as per C-19-010-000/AM-001. The guidelines for the annual inspection are contained in paragraph 17 of subject document and are as follows:

"In conjunction with the 100 hour inspection report an annual inspection shall be completed after the active training season has ceased and prior to storage. The annual inspection shall confirm that the engine is within factory specifications and the drive train, chassis, electrical and instrumentation is in good repair. A

designated person appointed by the RCA Ops O shall inspect the winch unit. All inspections and work performed shall be noted in the winch logbook."

The 'Daily Inspection' and the '100 Hour Inspection' would not normally detect an internal progressive break-down, such as a leaking power valve and fouled spark plugs.

2.3. The Winch Operator

This was the second launch by the occurrence winch operator. As the winch was being accelerated during the launch the winch operator focused his attention down field on the glider. As the glider became airborne, the winch operator felt, and heard, the winch engine sputter. He momentarily focused his attention on the engine tachometer, during which time the winch engine re-accelerated back to normal power. He re-focused on the glider and observed the glider flip 360^0 about its lateral axis. At this point he brought the winch engine to idle.

The delay in reducing the winch engine to idle allowed slack to develop in the tow-cable. The glider then over-flew the cable and drogue chute, which became entangled in the tail-wheel of the glider. The actual flip of the glider was caused when the winch engine surged back to maximum power and pulled the glider by its tail-wheel. In order to prevent this from occurring, the winch engine must be immediately reduced to idle, and the cable brake applied during any engine malfunction.

Chapter 5, section 2 of the Air Cadet Gliding Program Manual contains several paragraphs related to winch safety. However, there is no reference to the possibility of winch engine malfunction. Nor does the ACGP Manual emphasize the importance of immediately cutting power in the event of a power loss.

2.3.1. Winch Operator Qualifications

The following are the qualifications to become a winch operator:

"Qualification Title – Winch Launch Operator.

Duties. When so designated by the RCA Ops O, a Winch Launch Operator is authorized to conduct winch launches.

Prerequisites. The Winch Launch Operator shall:

(1) hold or shall have held a valid Canadian Glider or Private Pilot License or higher; and

(2) have successfully completed a course of instruction as follows:

(a) a briefing on winch launch procedures including normal and emergency SOPs, normal and emergency signals and local flying orders,

(b) the observation of a minimum of 10 winch launches conducted by a Winch Launch Instructor,

(c) the successful completion of a minimum of 10 winch launches under the direct supervision of a Winch Launch Instructor,

(d) practical application of emergency procedures including at least two simulated emergencies, and

(e) instruction and practical experience on associated equipment and rope/cable splicing, including a certification to carry out and authorize daily inspections (DIs)."

Paragraph 2 (a) and 2 (d) of Winch Operator Qualifications (above) does not specifically state which emergencies must be reviewed. It is possible that some individuals may be qualified as winch operators without being exposed to all emergency situations. More direction is required to ensure that all emergencies are identified and that these emergencies are covered during training.

3. CONCLUSIONS

3.1. Findings

3.1.1. The glider was serviceable prior to the accident. (1.6)

3.1.2. The winch was idling below the ‘normal’ idle range, and occasionally produced black smoke when full power was applied. (2.2)

3.1.3. There are no minimum or maximum limitations for winch engine operations. (2.2)

3.1.4. The power valve of the winch engine was leaking which caused a rich fuel mixture and fouling of the spark plugs. (2.2.1)

3.1.5. The winch engine suffered a momentary power loss. (2.1)

3.1.6. The winch operator focussed his attention from the glider, to the winch tachometer, and back to the glider. (2.3)

3.1.7. Local and Regional orders do not have a procedure for reporting winch engine abnormalities. (2.2)

3.1.8. The ‘Daily’ and ‘100 Hour’ inspections may not detect an internal, progressive break-down of components such as power valves. (2.2.2)

3.1.9. The qualification standards for winch operators do not ensure that the winch operator will be exposed to all winch emergencies. (2.3.1)

3.1.10. The ACGP Manual does not stress the importance of immediately cutting power and applying the drum brake in the event of a winch engine malfunction. (2.3)

3.2. Cause

3.2.1. The winch engine suffered a momentary power loss caused by a progressive fouling of the spark plugs that was due to a leaking power valve. (2.3.1)

3.2.2. When the winch engine power loss occurred, the winch operator hesitated prior to closing the throttle of the winch engine. (2.3)

4. SAFETY MEASURES

4.1. Safety Measures Taken

4.1.1. Fuel and winch were quarantined until release by DFS.

4.1.2. On 12 April 2006, Central Flying School ACGP Standards and Evaluation Team (SET) issued a National Pilot Information File (3/06) directing immediate response items to be conducted in the event of a winch power failure (Annex C).

4.1.3. ACGP SET has submitted a Winch Baseline Proposal (1085-1 (ACGP SET) 19 Jan 06. The proposal includes an inspection cycle, and proposed maintenance standards for all Air Cadet Winches.

4.1.4. Prairie Region Air Cadets is trialling a 25 foot weak link for the 2006 gliding season.

4.2. Safety Measures Recommended

4.2.1. The effectiveness and feasibility of locating all winch engine tachometers closer to the operator's line-of-sight should be studied. (3.1.5)

4.2.2. Winch operator training should include a "power loss" scenario with the immediate response being to close the winch throttle and apply the drum brake. (3.1.8)

4.2.3. The Air Cadet Gliding Program Manual, chapter 2, section 5, Winch Safety, should include a paragraph on the hazards of a winch engine malfunction and the requirement to immediately close the winch throttle and apply the cable brake. (3.1.9)

4.2.4. Engine manufacture's normal operating ranges should be marked on the engine instruments so people can assess if the winch engine is operating normally. (3.1.5)

4.2.5. Winch inspections should be amended to include items that will indicate a progressive break-down (i.e. spark plugs). (3.1.7)

4.2.6. Local and Regional Flying Orders should include procedures to report any winch malfunctions (similar to 'snagging' an aircraft). (3.1.6)

4.3. Other Safety Concerns

The glider winches employed in the gliding program are either owned by the Provincial Committees of the Air Cadet League of Canada, or the Department of National Defence. The Air Cadet League (ACL) is responsible for the maintenance of the winch, retrieval and launch equipment that they own as listed in the latest version of the ACL/MND Memorandum of Agreement. The

Canadian Forces is responsible for the maintenance of the DND winches and the provision of all consumables including the winch cable, weak link, retrieval chute and associated safety equipment. In order to standardize the wide variety of winches in operation, it is recommended that an agreement for winch maintenance and standardization be negotiated between DND and the Air Cadet League of Canada. This agreement should include items such as; overhaul cycle, inspection cycle, funding, and, update cycle.

4.4. DFS Remarks

It could be argued that a winch engine, used for launching Air Cadet gliders is an aeronautical product and therefore subject to the provisions of the DND Airworthiness Program. Whatever the outcome of this debate, it is obvious that a launch winch is a critical piece of equipment for the Air Cadet Gliding Program and it only makes sense to operate and maintain this equipment in accordance with airworthiness principles. The appropriate principles in question are that all the work is performed by authorized and qualified individuals who use authorized procedures and who perform the work to an accepted standard. If these simple principles are adopted, then the chances of winch related occurrences will be reduced substantially. It is therefore encouraging to see that the initial steps in adopting this approach are being made.

// ORIGINAL SIGNED BY//

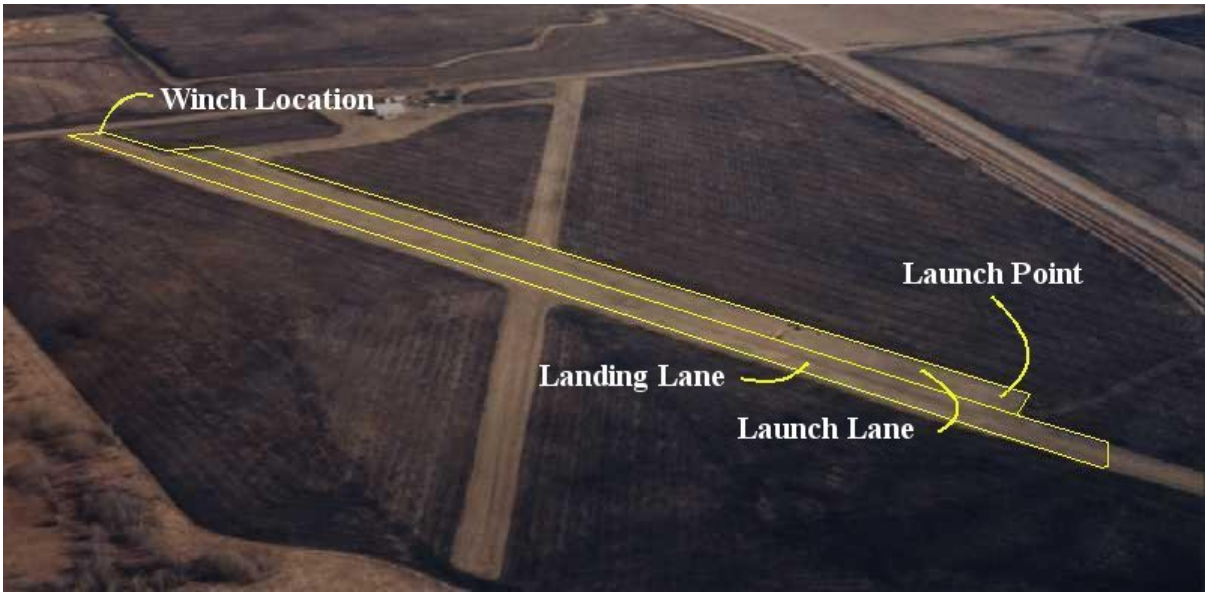
A.D. Hunter
Colonel
Director of Flight Safety

ANNEX A: PHOTOGRAPHS

Photograph 1: Damage to Glider

Photograph 2: Winch

Photograph 3: Cable, Chute, Weak Link



Photograph 4: Runway 32 Netook

Photograph 5: Winch Console

ANNEX B: ABBREVIATIONS:

ACGP	Air Cadet Gliding Program
ACL	Air Cadet League
AGL	Above Ground Level
AIA	Airworthiness Investigative Authority
ASI	Airspeed Indicator
ASL	Above Sea Level
CAR	Canadian Aviation Regulations
CO	Commanding Officer
DCO	Deputy Commanding Officer
DI	Daily Inspection
DND	Department of National Defence
DFS	Director of Flight Safety
ELT	Emergency Locator Transmitter
ERGS	Eastern Region Gliding School
FM	Frequency Modulated
IP	Instructor Pilot
KTS	Knots
LCO	Launch Control Officer
MF	Mandatory Frequency
MND	Minister of National Defence
MOA	Memorandum of Agreement

MSL	Mean Sea Level
PDI	Person of Direct Interest
QETE	Quality Engineering and Test Establishment
RCA Ops O	Regional Cadet Air Operations Officer
RPM	Revolutions Per Minute
SOP	Standard Operating Procedure
SP	Student Pilot
TAA	Technical Airworthiness Authority
TC	Transport Canada
VSI	Vertical Speed Indicator

NATIONAL PILOT INFORMATION FILE
3/06

CENTRAL FLYING SCHOOL
ACGP SET
12 Apr 06

Regional PIF # 0604

This PIF is issued under the authority of Col Cleland, Air Force Training, 1 Canadian Air Division Headquarters as OAA for the ACGP. Questions or comments may be directed to the ACGP SET at CFS Winnipeg.

1. Draft findings from the investigation into accident C-GFMC (Netook winching) have been reviewed by the SET. The SET concurs with the DFS recommendations and they warrant an adjustment to the information available to winch operators and their training.

2. **At any time that a winch experiences a momentary power loss, the immediate action shall be to close the winch throttle and apply the cable brake. Power shall not be re-applied to the winch until the power loss has been investigated, appropriate recovery actions have taken place at the glider end of the cable and a new launch sequence has been initiated. Effective immediately, winch operator certification training shall include discussion of a winch power loss scenario. This scenario may also be exercised as part of the "practical application of emergency procedures" detailed in the 242, Chap 1, Sect 3, para 23 c.(2)(d). Additionally, all winch operators are reminded that any time a winch appears or is suspected to be operating outside of normal parameters or in an unusual manner of any sort, they are responsible for ceasing winch operations until the nature of the problem can be investigated by a competent authority. Launches shall not continue with a winch operating in a degraded state such that normal operating procedures cannot be followed.**

3. The 242 will be amended during the next cycle following further review at the 2006 Standards Working Group.