CANADIAN FORCES
FLIGHT SAFETY INVESTIGATION REPORT (FSIR)

FINAL REPORT

FILE NUMBER: 1010-146493 (DFS 2-4)
DATE OF REPORT: 7 April 2006

AIRCRAFT TYPE: CH146 GRIFFON
DATE/TIME: 29 2255Z (1855 local) March 2004
LOCATION: 5 Wing Goose Bay
CATEGORY: "C" Category Accident

SYNOPSIS

The crew was flying a scheduled training mission for the co-pilot who needed simulated emergency practice. The emergency selected for the training was: 'High Side Governor Failure.' The co-pilot, in the left seat, was at the controls with the pilot performing non-flying pilot duties from the right seat. The emergency was briefed amongst the crew, followed by a simulation. The co-pilot correctly initiated the emergency by raising the collective. The pilot lowered the collective to regain single engine parameters in anticipation of switching the governor switch to manual. After identifying the governor switch and hearing "confirmed" by the flight engineer (FE), the pilot selected the governor switch to manual. Shortly thereafter, the 'ENG 2 OUT' and the 'FIRE 2 PULL' lights came on as the aircraft experienced a power loss of the number two engine. The pilot took control of the aircraft and the crew executed a number two Engine Fire Emergency procedure, successfully landing on a snowmobile trail just outside the perimeter fence of 5 Wing Goose Bay. Following shut down, extensive heat damage inside the number two engine compartment was noticed. Further investigation revealed extensive heat damage to the number two stage of the power turbine. The aircraft sustained "C" category damage.

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1. FACTUAL INFORMATION

GENERAL

The aircraft, Griffon CH146493, is a military version of the Bell 412EP, a multi-crew helicopter employed in the Combat Support (CS) role. The primary role for the aircraft is Search and Rescue (SAR) response and standby for the allied forces that mostly conduct fighter operations in the Goose Bay area. In this role the normal crew is two pilots, one flight engineer (FE) and a SAR Tech (ST). All aircraft are equipped with a rescue hoist on the right side of the airframe. CH146493 also carried a stokes litter; a specially designed stretcher used for helicopter casualty evacuations.

1.1 History of the Flight

The purpose of the flight was to carry out quarterly training for two co-pilots and one FE. The plan was to conduct one training sequence with one co-pilot, and then embark the second co-pilot who would take the left seat to conduct the Night Vision Goggles (NVG) training portion of the trip. The trip was scheduled to begin shortly before official “night time” so that the first training sequence could be completed during daylight.

The crew briefed at 1800 hrs local and prepared for their sortie. The briefing included all simulated emergencies as well as the NVG training sortie. The crew conducted a normal cold weather start at approximately 1815 hrs local. Following a proper instrument check the aircraft took off and headed east along the Churchill River and then returned towards the Base.

Once abeam the button of runway 08 a verbal discussion of the emergency procedure ‘High Side Governor Failure’ was carried out which included the symptoms, indications and proper reaction. A simulation followed the discussion. The correct initial response is to increase collective in order to maintain the Rotor RPM within limits, which was done by the co-pilot. The pilot then asked the co-pilot to lower the collective in order to regain single engine parameters (mast torque and airspeed) in anticipation of rolling the throttle to idle and switching the governor to manual. The pilot lowered the collective further and asked the FE to “Confirm no. 02 going away on us”, to which the FE responded: “confirmed”. The pilot then asked the other crewmembers for confirmation of the number two governor switch. After hearing the FE saying, “confirmed number two engine,” the pilot selected “manual” on the governor switch without first rolling the throttle to idle.

At this point, the pilot rolled the throttle to idle. Almost immediately, the crew noticed the “ENG 2 OUT” and “FIRE 2 PULL” lights illuminate. The pilot took control of the aircraft and turned towards an open area as the engine fire emergency procedure was initiated. The co-pilot pulled the number two fire

handle and selected the fire extinguisher to main and shortly after to reserve. He also sent a “mayday” call to the Goose Bay Control Tower. An emergency descent was initiated, terminating by a run-on landing to a snowmobile trail approximately three nautical miles southwest of the Base. As the aircraft stopped, the throttles were selected to off and an emergency egress was carried out.

The crew quickly confirmed that there was no fire present and returned to the aircraft to contact the Control Tower in order to update their situation. They were recovered by another CH146 helicopter approximately one hour later and returned to Base.

An examination of the aircraft revealed extensive damage inside the number two engine compartment consisting of burnt paint chips and metal discoloration caused by excessive heat.

1.2 Injuries to Personnel

There was no personnel injury resulting from this occurrence.

1.3 Damage to Aircraft

The inside of the engine compartment was covered by soot and burnt paint chips coming from the green primer paint of the exhaust duct cover. In addition, metal discoloration was present around the engine exhaust, the air bypass duct and the aft firewall.

Once the cowlings were removed, an examination of the number two stage of the power turbine revealed that nearly all the turbine blades had lost 20%-50% of their tips. Numerous dents were also found on the inside of the exhaust duct. Dents and scratches were found on both tail rotor blades and on the leading edge of the vertical stabilizer. The air by pass duct was also warped and discolored at the exhaust section.

An analysis of Health Usage and Monitoring System (HUMS) data revealed that the number two engine inter turbine temperature (ITT) reached a maximum value of 1,200^{o}C for 24 seconds. The allowable maximum continuous temperature is 810 ^{o}C.

The assessment of aircraft damage is "C" category.

1.4 Collateral Damage

No collateral damage resulted from this occurrence.

1.5 Personnel Information

	Pilot	Co-pilot	FE	SAR Tech
Aircrew Category valid	Cat I	Cat III	SAR FE	ST Lead
Currency requirements	All up to date	All up to date	All up to date	All up to date
Medical Category valid	28 Oct 04	5 Jul 04	Up to date	Up to date
Total flying time	3850	610	506	1113
Hours on type	433	363	451	33
Hours last 30 days	28	51	5	2
Duty time - Day of accident	8	11	6	11

1.6 Aircraft Information

CH146493 was declared fully serviceable at the time of flight. No technical or maintenance discrepancies were noted pre or post-occurrence.

1.7 Meteorological Information

The meteorological observation and forecast available to the crew were:

METAR: CYYR 292300Z 01005KT 15SM SCT090 BKN120 M02/M05 A3008
RMK AC4AC2 SLP190 SKY89=

TAF: CYYR 291733Z 291818 22010KT P6SM SCT110 BKN200
FM0000Z 23008KT P6SM SCT250
FM1100Z 22010G20KT P6SM FEW060 SCT250 BECMG 1315
23015G25KT
RMK NXT FCST BY 00Z=

1.8 Aid to Navigation

Nil.

1.9 Communications

The aircraft was communicating with the 5 Wing Goose Bay Control Tower. The co-pilot made a “mayday” call. After landing and after the crew confirmed that there was no fire present, an additional call was made from the aircraft to update the Tower on their situation.

1.10 Aerodrome Information

Goose Bay is a DND-operated facility in conjunction with the Goose Bay Airport Corporation. It is located near the town of Happy Valley Goose Bay, Labrador, and comprises two major runways. The airport is mostly used by allied air forces for fighter training. It is serviced by a category 8 Aircraft Rescue and Firefighting capability available 24 hours a day.

The Control Tower was in operation at the time of occurrence. It activated a “One Bell” crash alarm at 2251Z (1851 hrs local). The emergency was secured at 2310Z.

1.11 Flight Recorders

CH146493 was equipped with a standard CH146 combined cockpit voice / flight data recorder (CVFDR). It was removed and shipped to National Research Council (NRC) in Ottawa by the investigation team for analysis. The aircraft HUMS data was downloaded and the information was analysed by 444 (CSS) SQN.

1.12 Wreckage and Impact Information

The aircraft was recovered by 444 (CSS) SQN personnel the following day. It was taken inside the unit’s hangar and kept in quarantine.

1.13 Medical

The four aircrew members were sent to the 5 Wing Hospital where toxicology samples were taken at 2100 hrs local. The samples were sent to the Armed Forces Institute of Pathology, Maryland, for analysis. The results showed that two crewmembers tested positive for self-medication.

1.14 Fire, Explosives Devices, and Munitions

The aircraft was equipped with portable fire extinguishers and on-board fire bottles that are ducted to the engines. There was no evidence of post-occurrence fire. The two on board fire bottles were found empty. The fire bottle extinguisher selector switch was found in the reserve position.

The only munition carried on the aircraft is part of the hoist, which is equipped with an explosive cable cutter.

1.15 Survival Aspects

Survival aspects were not considered in this investigation since the aircraft landed safely near the Base and the crew was uninjured.

1.16 Test and Research Activities

The CVFDR was shipped to NRC Ottawa for analysis. The HUMS tape was read using unit equipment.

1.17 Organizational and Management Information

The occurrence aircraft and crew were all from 5 Wing, 444 (CSS) SQN Goose Bay, NF.

1.18 Additional Information

Nil.

1.19 Useful or Effective Investigation Techniques

Nil.

2. ANALYSIS

2.1 The Crew

The pilot was a qualified and current CH146 Standards Officer and Category I SAR pilot. He also assumed Unit Training Officer duties because of a shortage of experienced pilots at the unit. He occupied the right seat and was carrying out non-flying pilot duties at the time of occurrence. His Crew Resources Management (CRM) training was up to date and due in Jan 05.

The co-pilot was a junior captain who completed pilot training in Sep 02 and CH146 Basic First Officer Training in Apr 03. He held a Category III on the CH146. Seated in the left seat, he was at the controls at the time of occurrence. His CRM training was up to date and due on 17 Apr 04.

An FE and an ST were occupying the back seats. The FE held a current SAR Category. He had been medically grounded for seven weeks following an injury before the accident and was undergoing proficiency flying training. The occurrence flight was his third flight following his return to flying status. His CRM recurrent training had expired. It was due on 12 Feb 04.

2.2 Emergency Simulations

Emergency simulation by CH146 crews is a routine and frequent activity. The aim of emergency procedure training is to train aircrew in handling actual emergencies to reduce aircraft incident and accident rates. Applicable Flying Orders, the C-12-146-000/MB-002 CH146 Flight Manual, the CH146 Flight Crew Check List and the CFACM 40-46 - CH146 Standard Manoeuvres Manual (SMM – designated since Aug 04 as B-GA-002-146/FP-001), govern the practice.

Simulated emergencies are practised using two means to ensure that safety and effectiveness are optimized. The CH146 Flight Training Simulator at 403 (H) Operational Training Squadron in Gagetown, NB, is used mainly for high-risk emergency procedures while the aircraft is utilized for all others. While practising emergency procedures in CH146 aircraft, two simulation methods ensure that caution is exercised, preventing the inadvertent initiation of an actual in-flight emergency. The first method, verbal simulation, allows the pilot to verbalize symptoms and corresponding emergency procedures while flying. There is no selection of switches and/or specific control inputs when using this method. The other method is practical simulation using control inputs and/or switch selection to artificially generate a malfunction, allowing the response to be carried out in-flight. The CH146 SMM describes the method to use for each emergency simulation situation.

2.3 Manual Governor Changeover Procedure

The procedure that must be used when an AC decides to change a governor switch from automatic to the manual mode during a real or a practice governor malfunction is listed in the CH146 SMM. At the time of occurrence the procedure was as follows (CFACM 40-46 CH5 1999-08-18) (Assume no. 1 engine has a low side governor malfunction):

a. Control the helicopter:

(1) FP: Control the helicopter and state “We have a power problem... we are within OEI, investigate.”

(2) NFP: State symptoms and make a judgement… "We have a possible low side on #1.”

b. Secure the emergency:

(1) AC: confirm the emergency and direct the crew when to start the checklist response.

(2) FP: “I have #2 at full, complete a manual changeover on #1, give it back to me at 65%.”

(3) NFP rolls #1 to idle, confirms idle and identifies #1 governor switch with FE/FP, indicates and changes governor to manual and winds up to 65%. "You have #1, I have #2.

NOTE

FP shall always have his/her hands on the throttles.

(4) NFP: “monitoring the torque split” (NFP calls the torque split in excess of 10%, matched or exceeding good engine torque.) FP advances #1 engine’s throttle to approximately 5% less torque than #2 engine.

c. Complete the checklist procedure:
FE/NFP review checklist to ensure all items have been covered.

d. Conduct the landing:
FP conducts shallow approach to a no-hover landing, minimizing collective inputs and adjusting throttle as required. (Hover or short run-on are also options)

e. After landing:

(1) Upon landing, reduce manual throttle to approximately 65% N1 as collective is lowered.

(2) For training only: When stabilized, FP rolls throttle to idle stop then switches to AUTO (as per daily engine fuel control check.).

2.4 The Task

Once the aircraft was abeam the button of runway 08 at an altitude of 600 feet, and with the co-pilot flying, the pilot asked the co-pilot how he would recognize a high side governor failure. The co-pilot verbalized that he would hear the rotor increasing in RPM, and would visually observe an increasing rotor RPM indication on the Nr gauge. He said that he would adjust collective to maintain Nr as required and he began to raise the collective, effectively carrying out a practical simulation. The pilot agreed, and then asked the co-pilot to lower the collective to within single engine parameters. The pilot himself then pushed the collective down further to continue with the emergency. He stated that they would continue with the rest of the emergency, asking the FE to back him up on the checklist. The co-pilot (flying) gave the proper orders to the pilot to switch number two engine Fuel Control Unit (FCU) to manual, as per para. 2.3 b. (2) above.

The pilot asked the FE to “Confirm no. 02 going away on us”. The FE and the co-pilot both noted that they saw the pilot pointing at the no 02 engine Gas Producer RPM (N1) gauge at that time, which the pilot wanted confirmed. The pilot however does not recall pointing at the gauge. The FE was pulling out his checklist and finding the correct emergency page when he said: “confirmed.” The pilot then moved his finger to the governor selection switch (which is an “identify-confirm-move” switch) and asked for confirmation of the correct switch. The FE confirmed that the pilot was touching number two governor switch. Although the co-pilot looked at the no 02 engine N1 gauge and realized it was not at flight idle, he did not verbalize this fact with the other crewmembers. The pilot then activated the switch, bypassing the automatic fuel control unit on the number two engine and switching the fuel control to manual. Very quickly following movement of the switch, both the co-pilot and the FE saw the ITT (inter turbine temperature) gauge spike to 1090^{o}C. The engine began to falter and shutdown. The pilot quickly rolled the throttle for number two engine to idle, and he took control of the aircraft from the co-pilot.

The ENG 2 OUT light illuminated, followed shortly thereafter by the FIRE 2 PULL light. The co-pilot (now the non-flying pilot) put his hand on the number two fire handle (FIRE 2 PULL) and mistakenly asked for confirmation of a fire light for the number one engine. Both the FE and the pilot (now the flying pilot) corrected the co-pilot by stating that it was the number two engine. The co-pilot then pulled the number two handle and activated the main fire suppressant bottle. The pilot

began an emergency descent while the co-pilot selected ‘reserve’ to activate the reserve fire suppressant bottle, 13 seconds after activating the main. Simultaneously, the co-pilot declared mayday with the Goose Bay Control Tower. The pilot performed a run-on landing onto a wide portion of a snowmobile trail. After the aircraft came to rest, the crew conducted the emergency egress procedure and gathered approximately 50 feet from the nose of the aircraft.

2.5 Human Factors

The investigation determined that the aircraft was serviceable prior to switching the FCU to manual and that the weather was not a factor at the time of occurrence. The crew was properly authorized, qualified and current for the mission with the exception of one crew member whose CRM (now called Human Performance in Military Aircraft – HPMA) training had expired. and two of the crew members were medically unfit for flying because of their self medication

2.5.1 Active Cause Factors

The Human Factors Analysis and Classifications System (HFACS) adopted by the CF was utilized for this portion of the analysis. The following descriptors are part of that classification system and are utilized herein to explain the reasons for this accident.

2.5.1.1 Unsafe Acts

The following four unsafe acts were identified in this occurrence:

a. The pilot missed the checklist item of rolling the throttle to idle prior to switching the FCU to manual (step number three in the CH146 Flight Crew Checklist);

b. The pilot did not read the N1 gauge when he asked the FE for confirmation;

c. The FE did not read the N1 gauge when responding to the pilot; and,

d. The co-pilot did not assertively state that the number two engine was not at idle prior to the movement of the governor switch, despite his correct reading of the number two engine RPM gauge.

2.5.1.1.1 The first unsafe act – The pilot missed the checklist item of rolling the throttle to idle prior to switching the FCU to manual.

This is an attention / memory error. Just prior to beginning the procedure, the pilot had placed his hand on the collective and pushed it down slightly to regain single engine parameters. The action of putting in a control input using the

collective may have made him think he had already rolled the number two throttle to idle. While placing his hand on the collective, the pilot was at the same time listening to and assessing the co-pilot as he explained the signs, symptoms and treatment of a high side governor failure. He was also monitoring the mast torque and airspeed indications of the aircraft to ensure it was in single engine parameters before continuing with the rest of the emergency simulation. This division of attention would have exacerbated the chance of failing to notice that he had not rolled the number two throttle to idle.

2.5.1.1.2. The second unsafe act – The pilot did not read the N1 gauge when he asked the FE for confirmation.

This is also considered an attention / memory error. The FCU changeover procedure is considered a “bold print” procedure, meaning it is performed from memory without reference to a checklist. Just prior to and while performing the FCU changeover procedure, the pilot was at the same time listening to and assessing the co-pilot as he controlled the emergency and flew the aircraft. He was also monitoring the mast torque and airspeed indications of the aircraft to ensure it was in single engine parameters prior to continuing with the rest of the emergency. It is assessed that the pilot failed to read the gauge as he was overloaded with information, and had begun to shed data to speed up his information processing abilities. Another likely possibility is that the pilot was simply distracted with all the activity he had to monitor and his attention was focused elsewhere prior to goal attainment.

The pilot stated that he normally read the gauge value verbally when confirming RPM and that he did not know why he did not do so in this case. Regardless, the action performed was not the intended action, and thus represents an action failure. In this case, the pilot chose the correct action (to read and confirm the N1 gauge) but missed the actual step of reading the N1 gauge. This is generally caused by a memory failure (forgetfulness) and is often associated with an interruption or a distraction.

2.5.1.1.3 The third unsafe act – The FE did not read the N1 Gauge.

This is an attention error. Although the FE attempted to confirm the engine was at idle by checking the N1 gauge, he did not actually read it. It is likely he believed the throttle was already at idle and thus did not concentrate on interpreting the gauge. The FE had the capability to understand the information, however, he was trying to use his checklist at that time and was distracted and thus unprepared to back up the pilot. When the pilot asked for backup from the FE and continued immediately into performing the FCU switchover, he inadvertently placed the FE under time pressure.

The FE should have performed this procedure from memory since this item is a “bold print” procedure. In attempting to use his checklist, the FE exacerbated the

time pressure he was feeling. Because he chose to use the checklist, the FE had to move forward into position to view the instruments and switches, find his checklist, find the correct page in the checklist, and ensure the pilot was indeed following the correct steps. When the pilot asked him to confirm the N1 gauge, the FE was still in the process of finding the correct page. He glanced up, saw the pilot's finger below the N1 gauge, and said, "confirmed" before returning his attention to his checklist. The information was present and was not illusory or ambiguous. Therefore, there was a failure in time management. This type of failure is usually due to an inappropriate or incorrect prioritization of attention.

2.5.1.1.4 The fourth unsafe act – The co-pilot did not assertively state that the number two engine was not at idle prior to the movement of the governor switch, despite his correct reading of the number two engine RPM gauge.

This is a decision error. Although he was aware the number two engine was not at idle prior to the movement of the FCU selection switch, the co-pilot did not attempt to stop the changeover procedure.

The co-pilot was flying the aircraft while the pilot performed the procedure for a FCU changeover. The co-pilot was aware there was a missed step in the checklist and was also aware that the N1 gauge was not reading correctly; however, he chose to take no action to warn the pilot. He was not under any perceived time pressure. This represents an action failure, specifically a failure in selection of the correct action. This particular failure represents a breakdown in the decision process rather than errors in perceptual data.

2.5.2 Latent Cause Factors.

2.5.2.1 Conditions of personnel.

<u>Psychological state – pilot:</u> Just prior to the first two unsafe acts, the pilot had placed his hand on the collective and pushed it down slightly to regain single engine parameters. It is possible that the action of making a control input using the collective might have made the pilot think he had already rolled the no. 02 throttle to idle. While placing his hand on the collective, the pilot was at the same time listening to and assessing the co-pilot explain the signs, symptoms and treatment of a high side governor failure. The pilot was also monitoring the attitude and airspeed of the aircraft to ensure it was in single engine parameters prior to continuing with the rest of the emergency. This division of attention exacerbated the chance of failing to notice that he had not rolled the #2 throttle to idle.

Lapses of this nature are often the result of an interruption in the processing of information. It is assessed that the pilot did not read the gauge because he was overloaded with information, and had begun to shed data to speed up his information processing abilities. Another possibility is that the pilot was simply

distracted with all the activity he had to monitor and his attention was focused elsewhere prior to goal attainment.

Psychological state – FE: The FE was trying to backup the pilot using the checklist instead of memory. Because of this he was focused on the action of searching for the correct page, and was not paying full attention to what the pilot was telling him or where they were in the procedure. This distraction likely caused him to automatically confirm the N1 gauge instead of taking the time to read it properly first. His attention was only truly focused on the aircraft and the procedure after he had found his place in the checklist and after the FCU switch had been moved.

Psychological state - co-pilot: The pilot was a very experienced pilot who held a senior officer rank. The co-pilot was a relatively new low-time pilot who held junior officer rank. Typically this mix of experience and rank creates a cockpit gradient. Both the FE and the co-pilot were very comfortable flying with the pilot and this latter individual endeavoured to create a work environment in the cockpit that emphasized open communication between all crewmembers. Although the co-pilot was aware engine number two was not at idle before the pilot moved the governor switch to manual, he was reluctant to correct the pilot prior to switch movement.

Physiological state: Toxicological samples were taken from all aircrew, results showed that two crewmembers tested positive for self-medication. However, this is not deemed to be a factor in this occurrence.

2.5.2.2 Supervision

No supervision latent cause factor has been assigned to this occurrence.

2.5.2.3 Organizational Influence.

Resource management – SMM: The SMM procedure for solving a governor failure was changed in 1998. In the previous procedure, a clearly written and highly scripted interchange occurred between the Flying Pilot (FP) and the rest of the crew. Further, the FP had positive control over the flow and timing of the procedure throughout, including important checkpoints. When the procedure was changed in 1998, that positive control was lost. In the new procedure, the FP simply needs to state, “I have engine number X at full. Complete a manual changeover on engine number Y and give it back to me at 65%.” Although primarily the same procedure, the new checklist is much less scripted stating simply “NFP rolls number one to idle, confirms idle and identifies number one governor switch with the FE/FP, indicates and changes governor to manual and winds up to 65%.” It is unclear why the terminology change occurred between the two manuals, however from a human factors standpoint, the older procedure was much more deliberate and clearer in its process.

Resource management – Human resources/staffing/manning: The personnel management guidelines (promulgated in *3010-7 A3 Tactical Aviation Readiness 25 Mar 02 - Concept of Operations (CONOPS) – Combat Support Capability)* state that two of the eight positions within a CSS unit may be filled with inexperienced first tour pilots. At the time of the occurrence, the squadron was operating with seven pilots, of which four were first tour. This manning deficiency may have placed unrealistic workload demands on the pilot, at the expense of optimized human performance.

2.5.3 SUMMARY

In summary, the human factors that contributed to this accident are:

a. The pilot experienced an attention failure. The pilot dividing his attention amongst too many information inputs likely brought about this failure.

b. The pilot did not actually read the N1 gauge when he asked to have it confirmed.

c. It is likely the FE may have automatically confirmed the N1 gauge without reading it because his attention was distracted with finding his place in the checklist.

d. The co-pilot did not state that the number two throttle was not in the idle position before switch movement, although he was aware of it. His decision to take no action represents an action failure, in particular a failure in action selection. It is assessed that a cockpit authority gradient existed at the time of this accident and the co pilot did not overcome this gradient at a critical stage of the flight.

3. CONCLUSIONS

3.1 Findings

3.1.1 The aircraft was serviceable prior to the occurrence.

3.1.2 The weather was within limits and was not a factor.

3.1.3 The crew was qualified and current for the mission.

3.1.4 The pilot missed the step of rolling the throttle to idle prior to selecting the FCU switch to manual.

3.1.5 The pilot did not confirm that the corresponding engine was at idle prior to selecting the FCU switch to manual.

3.1.6 The FE did not read the N1 RPM gauge of the number two engine when asked for confirmation of engine position.

3.1.7 The co-pilot did not state that the number two engine was not at idle despite correctly reading the number two engine RPM gauge.

3.1.8 Two crewmembers tested positive for self-medication but this was not a factor in the occurrence.

3.1.9 CRM recurrent training had expired for one member of the crew.

3.1.10 The squadron was operating with a pilot manning level below that established in the CONOPS.

3.2 Cause

This accident was caused when the critical step of rolling the number two throttle to flight idle, prior to switching the number two engine governor to manual, was missed.

3.3 Contributing Factors

A serious break down in CRM procedures by the pilot, co-pilot and FE contributed to this occurrence. Each member missed at least one item in the FCU changeover procedure. If the pilot had confirmed the engine position, if the FE had read the engine RPM gauge or if the co-pilot had assertively stated the engine position prior to selecting the governor switch to manual, this accident would not have occurred.

4. SAFETY MEASURES

4.1 Safety Measures Taken

4.1.1 All unit aircrew were reminded of the importance in following proper checklist procedures. Of particular note, the aspect of visual confirmation during critical phases in crew situations was covered.

4.1.2 The B-GA-002-146/FP-001 CH146 SMM, introduced in Aug 04, contained a re-worded Manual Governor Changeover Procedure. This better addressed the need of incorporating a positive control step into the procedure.

4.2 Safety Measures Recommended

4.2.1 It is recommended that when flying units conduct recurrent HPMA training, an emphasis be placed on the proper identification of information available from cockpit instrumentation when conducting checks as well as timely and assertive crew communications.

4.2.2 It is recommended that the Manual Governor Changeover Procedure be further enhanced so that FE/FP verbal confirmation is received by the NFP in response to his own verbal verification that the N1 reading is at idle.

4.2.3 It is recommended that aircrew be reminded of the risks involved with self-medication.

4.2.4 It is recommended that unit procedures for conducting approved simulated "bold print" emergency procedures emphasize the necessity of conducting these procedures from memory.

4.2.5 It is recommended that the manning level established in the CONOPS be adhered to in order to mitigate the risks associated with high supervisory workload.

4.3 Other Safety Concerns

Nil.

4.4 DFS Remarks

The investigation into this accident was thorough and a number of useful preventive measures have been identified. However, this investigation has raised two peripheral factors. While these issues were not directly causal to the accident, they are nonetheless of concern. The first issue relates to the increasing demands that are being placed on supervisors. In this particular case, the pilot was the standards officer and the training officer due to lack of experienced pilots on the unit. He also had a number of additional important responsibilities. Anecdotal information as well as other flight safety investigations (such as FSIR CF-188733) indicate this type of situation is becoming more and more common; both with aircrew and with aircraft maintenance organization supervisors. In addition, all indications are that this situation is going to continue for the foreseeable future. In order to ensure that this does not become a flight safety problem, commanders at all levels must know when to say "no" and start load shedding. From a flight safety perspective, this important message must be stressed continually.

The second issue concerns self-medication. This is at least the fourth example of aircrew self-medication within the past five years. These statistics are very disappointing, as it appears that the message is not getting through to some personnel. In an effort to rectify this situation, this issue is being stressed during the annual DFS briefing to units and wings. In addition, this topic will be featured in a future Flight Comment article and poster.

//ORIGINAL SIGNED BY//

A.D. Hunter
Colonel
Director of Flight Safety

ANNEX A: PHOTOGRAPHS

Photo 1: Number two Engine Compartment showing sooth, burnt paint and discoloration.

Photo 2: Number two engine, showing blade damage to the second stage of Power Turbine, as seen through the exhaust.

ANNEX B: LIST OF ABBREVIATIONS

CSS	Combat Service Support
CRM	Crew Resource Management
CVFDR	Cockpit Voice Flight Data Recorder
FCU	Fuel Control Unit
FE	Flight Engineer
FP	Flying Pilot
HFACS	Human Factors Analysis and Classification System
HPMA	Human Performance in Military Aviation
HUMS	Health Usage Monitoring System
ITT	Inlet Turbine Temperature
NFP	Non-flying Pilot
NRC	National Research Council
NVG	Night Vision Goggles
SAR	Search and Rescue
SMM	Standard Maneuvers Manual
SQN	Squadron
ST	SAR Tech