AIRCRAFT ACCIDENT REPORT NUMBER RCAA-ACCID-018

RAMP COLLISION, RWANDAIR FLIGHT 205, OPERATED BY JETLINK BOMBARDIER CL-600-2B19, REGISTRATION 5Y-JLD, KIGALI INTERNATIONAL AIRPORT, 12 NOVEMBER 2009

PURPOSE OF THE INVESTIGATION:

In terms of regulation 3 of the Rwanda Civil Aviation (Aircraft Accident and Incident Investigation) Regulations this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or establish legal liability.

ORGANIZATION OF THE INVESTIGATION

Pursuant to Rwanda Civil Aviation (Aircraft Accident and Incident Investigation) Regulations 2008 (Annex XVII to the Presidential Order N° 60/01 of 20/10/2008) and Annex 13 to the Convention on International Civil Aviation, the Ministry of Infrastructure on behalf the Republic of Rwanda, the State of Occurrence, launched an investigation.

In accordance with the provisions of the Regulations and Annex 13 to the Convention on International Civil Aviation, Rwanda, the State of occurrence, sent notifications to Kenya the State of registration, Canada the State of aircraft design and manufacture, and United States of America the State of engine manufacture, as well as to the International Civil Aviation Organization (ICAO). The notified States appointed accredited representative of which the Kenya and USA traveled to participate in the investigation.

EXECUTIVE SUMMARY

Synopsis

Shortly after takeoff, when the Copilot pulled back the thrust levers of both engines to the desired positions, the thrust lever on left engine could not move and the engine remained in full power. The Pilot in Command (PIC) then informed Air Traffic Controller (ATC) that the aircraft had a technical problem and requested to return to the airport. The crew managed to land safely with the Copilot and accompanying company maintenance engineer struggling to control the left engine which was on high power setting and the PIC controlling the aircraft using only the right hand engine. The aircraft taxied to parking bay number 4 with the left engine still in full power. The captain applied the parking brake and the aircraft stopped for a while and before putting on the chocks, the aircraft started moving forward at a high speed through the jet blast fence and crashed into Control Tower building.

Probable Cause

The flight crew's failure to identify corrective action and their lack of knowledge of applicable airplane and engine systems in response to a jammed thrust lever, which resulted in the number 1 engine operating at high power and the airplane configured in an unsafe condition that led to the need to apply heavy braking during landing. Also causal was the flightcrew failure to recognize the safety hazard that existed from overheated brakes and the potential consequence on the braking action needed to park the airplane. Contributing factors included the possible failure by maintenance crew to correctly stow the upper core cowl support strut after maintenance, Flightcrew's failure to follow standard operating procedures, the company's failure to be availed to manufacturer safety literature on the subject, and the susceptibility of the cowl core support shaft to interfere with the throttle control mechanism when the core strut is not in its stowed position.

Recommendations

In order to ensure flight crew members are adequately equipped with knowledge and skills critical to handle abnormal and emergency situations, States of Registry and operators should ensure that addition of a rating or upgrading to captaincy is done when the incumbent completes an initial training program covering at least all abnormal and emergency procedures.

Operator Safety Management Systems should be enhanced to include scanning for safety related information from the manufacturer and other sources and ensure effective sharing of information throughout the organization.

1. FACTUAL INFORMATION

1.1 History of Flight

On November 12, 2009, about 1315 hours local time[1], RwandAir (WB) flight 205 , a Bombardier CL 600-2B19 [2], 5Y-JLD, operated by Jetlink Express Limited, traveled uncommanded from a parking position and struck the Air Traffic Control Tower building at Kigali International Airport (KGL). The flight crew had executed an air turn back to KGL shortly after takeoff when they were unable to reduce the power of the number one (left) engine. Visual meteorological conditions prevailed and an instrument flight plan was filed. Of the 15 persons on board, including the 4 crew members, one passenger was fatally injured. The pilot, copilot, and one passenger[3] were seriously injured. The airplane was substantially damaged and there was no fire. The flight had been bound for Entebbe, Uganda.

Flight WB205 proceeded through the pre-takeoff ground operation without incident followed by takeoff on runway 10 at 1254 hours. During the initial takeoff climb, the flight crew experienced a jammed thrust lever for the number 1 (left) engine and was unable to reduce the power. The PIC notified air traffic control, and entered into a holding pattern, while the first officer and accompanying company maintenance engineer[4] who was summoned from the cabin unsuccessfully tried to rectify the jammed throttle problem. The captain decided to return to KGL where, on a second attempt, a landing was performed on runway 28. He then taxied to the parking bay where he stopped the airplane, shut down the number 2 (right) engine; however the number 1 engine continued to operate at high power settings.

According to the PIC, "after getting airborne, I asked my copilot to conduct the climb and after takeoff checks. She had a problem with retarding the left thrust lever. I called the engineer to help the copilot retard the left throttle, but it was not possible. I asked the tower controller for permission to land. I landed with one engine on maximum power and landed normally though heavy braking, the tires deflated and parked the aircraft and shortly the plane started rolling downwards toward the barrier and Air Traffic Control Tower building. I had no control over the plane as I even tried to steer it clear of the building."

According to the first officer, "after takeoff, I tried to set climb thrust and noticed the left thrust lever could not adjust. I then informed the captain that the throttle was stuck. He tried to adjust it too but it was stuck. We then called for the engineer, we coordinated together and the captain focused on flying the plane safely while I communicated with ATC, did the checklists and we combined efforts with the engineer to try and adjust the left thrust lever. We landed safely and

[1] All times herein are local time based on the 24-hour clock
[2] The accident airplane was a Canadair Jet (CRJ) 100 model, which is one of three models in the CL-600-2B19 series. (The other two models are the CRJ200 and CRJ440). Bombardier acquired Canadair in December 1986.
[3] An engineer who was seated in the cabin and was onboard as a non-revenue passenger
[4] Herein to be referred to as "the engineer"

parked but the left trust lever could not be adjusted still. As we were trying to retard it and shut it down while holding on brakes, the plane started rolling again. Efforts to stop it from rolling failed but the captain managed to control it away from the other traffic. We then hit a wall as the plane could not stop and the thrust lever was still stuck forward."

The recorded audio of the cockpit voice recorder and the data from the flight data recorder for the entire flight, covering a period from 12:53:55 to 13:11:33, was reviewed. A transcript was produced of the CVR audio tape for the time period from the takeoff to the accident. Plots were produced from the FDR data. The data from the CVR and FDR were correlated to determine the following chronology of the flight.

At 12:54:57[5], the aircraft lifted off with the number one and two engines at 94% and 91% power respectively. At this time, Engine 1 N1 was 94% and Engine 2 N1 was 91% while the pressure altitude was about 4,800 feet. During the takeoff roll the flight crew noticed the throttle was stuck and continued to discuss the problem during the initial climb. About 12:57:00 at an altitude of 8900 feet, the number 2 engine power decreased to 69% and the number one engine remained at 94%. Engine 2 N1 decreased to 69%, Engine 1 N1 remained at 94% and the pressure altitude increased to about 8,900 feet.

The CVR audio tape suggests the flight crew first noticed during the takeoff roll that the thrust lever for the number one engine was jammed, but continued with the takeoff. About a minute and 45 seconds later, during the climb out, they called the accompanying maintenance engineer into the cockpit to help rectify the problem with the left throttle. The engineer arrived less than 2 minutes later (12:57:32). About 45 seconds afterward, the PIC informed the passengers the flight will be returning to Kigali due to a technical problem.

At 12:57:01, the number 1 engine increased to 97% and the Automatic Power Reserve Command (APR Cmd) transitioned from "Not Active" to "Active" and remained "Active" until the end of the FDR recording.

At 12:59:46, the aircraft started its descent at a pressure altitude of about 9,400 feet while the power for number 1 and number 2 engines decreased respectively to 96% and 32%.

At 13:02:06, the Number 1 engine was at 95% and the no. 2 engine N1[6] decreased to 30%, and the pressure altitude decreased to about 7,000 feet. For the next 4 minutes and 42 seconds, the no. 2 engine varied from 88% to 27% while the no. 1 engine remained steady at about 95%.

During the ensuring period after the decision to land, the flight crew executed a circling descent to lose altitude, and set up the airplane for the approach and landing, while the copilot and accompanying engineer continuously tried to retard the throttle. The captain also expressed concerns that the engine could overheat. The flightcrew made no discussion at any time about referencing the quick reference handbook, flight crew operating manual, or airplane flight manual.

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[5] The time that the weight on wheel (WOW) indication for the nose and main gear transitioned from ground to air mode

[6] N1 is the rotation speed of the low pressure compressor

At 13:06:48[7], the airplane landed on runway 28 with the number 1 and 2 engines at 95% and 27% power respectively.

Three minutes and 17 seconds later after landing, the ground speed was 0 knots for a duration of 1 minute and 16 seconds (from 13:10:05 until 13:11:21). According to the CVR, after landing until the airplane came to a stop on the ramp, the flight crew continued to discuss the engine problem and trying to determine how to shut down the power to it. About 1minute and 40 seconds after the landing, the copilot expressed "How will we stop the engine then", the PIC replied "We'll just think it over, it's a problem." Simultaneously, there were the separate sounds for the brake warning of which the copilot acknowledged with the call out of "brake overheat". Based on the FDR data, the right engine was subsequently shut down. The purser was called to the flight deck where the PIC explained to him that the left engine could not be shut down and discussed the possibility of exiting the passengers out the right side of the airplane through the galley door. He also instructed the purser not to open the door and "relax until I give you the green light."

According to the FDR data, after the time the airplane had stopped, during the period from 13:11:21 to 13:11:31 the ground speed increased to a maximum of 23 knots of which time according to the CVR, the flight crew noticed the airplane had started to move. They called out for the engineer and the PIC called out for the placement of the chocks. The sounds of screaming were followed by the sounds of a crash.

The FDR indicated that during the time from 13:11:31 to 13:11:33, vertical acceleration decreased from 0.88 g to -0.02 g, longitudinal acceleration decreased from 0 g to -1.08 g, and lateral acceleration increased from 0.29 g to 0.91 g then decreased to -0.78 g.

A witness, who was located about 200 meters south of the runway reported he saw the airplane takeoff and about 2 minutes later saw it returned to land. According to the witness "after touchdown, I didn't hear (the pilot) reduce the power. He diverted his attention elsewhere and noticed it later as it was headed "uncontrollable" toward the building after it first struck wind barriers. He noticed fire trucks arrived about 3 to 5 minutes later and water was sprayed into the engine intake to shut down the engines, which prompted him to proceed to the accident site. He arrived at the accident site and 10 minutes after the crash the engine continued to operate. He eventually gained access to the cockpit where he saw the copilot trapped by the instrument panel that had collapsed on her legs. He attempted to locate the fire shutoff valves and noticed the left and right throttles were respectively in the maximum and full power positions. He retarded the throttle to the shutdown position and the engine responded accordingly.

A second witness, who was a member of the ground marshals handling flight WA205, reported that he was in the ramp area when the airplane returned to the airport. According to the witness, after the airplane had been chocked in parking bay number 4, he noticed the aircraft began moving toward him. He ran from the path of the airplane, and stated "it made so much noise and a company ground personnel, who was near was pushed out by the jet blast. The aircraft went and hit the Air

[7] The time the WOW indication the left main gear transitioned to from air to ground mode

Traffic Control Tower building staff room and stopped. The nose section of the aircraft entered and the engines were still running."

1.2 Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	0	1	1	0
Serious	2	1[8]	3	0
Minor	1	2	3	0
None	1	7	8	0
TOTAL	4	11	15	0

1.3 Damage to airplane

The aircraft was substantially damaged. Wings detached from the front attachment points. The aircraft nose section and the cockpit area were damaged.

1.4 Other damage

An Air Traffic Control Tower building sustained moderate damages. Three (3) Jet blast barriers were damaged

1.5 Personnel information

The flight crew consisted of a pilot, co-pilot, two cabin crew members and an "engineer" flying as a non-revenue passenger. The cabin crew was on a permanent working contract with RwandAir. According to the available records, the cockpit crew composition had been the same since the contractual agreement between RwandAir and Jetlink commenced in November 2008. Records indicate the engineer was replaced sometime in January 2009. The review of the records disclosed the crew's duty time had occasionally exceeded 12 hours per day.

1.5.1 The Pilot In Command

The Pilot in Command (PIC), aged 37 held a Kenyan Airline transport license and a Kenya Civil Aviation Authority (KCAA) first class medical certificate dated 8 June 2009 with no limitations.

According to interview of the PIC and KCAA records, the pilot first began flight training and acquired his private pilot license in 1991 and commercial pilot license in December 1992 (FAA Certificate No. 2474267). He obtained International Civil Aviation Organization Air Transport

[8] The engineer was seated in the cabin and was onboard as a non-revenue passenger

Pilot License in 2001. He subsequently received type ratings in the Let 410, Piper PA-34, and Beech 1900 before he was employed with Jetlink beginning of 2009.

According to PIC, the logbook and company records, he had flown about 11,478 hours total flight time, including about 1,110 hours in the CRJ100. He had flown about 77, 17, and 0.3 hours in the previous 30 days, 7 days and 24 hours, respectively, before the accident. He received his initial type rating on the CRJ100 on 9 March 2009 and the company release to PIC upgrade on 24 March 2009. According to CAA records, PIC had flown 748 hours on CRJ100 prior to endorsement of the rating on 9 March 2009. His most recent proficiency check and ground training occurred on 3 June 2009.

1.5.2 The First Officer

The first officer, age 27 years, held a commercial pilot license with a type rating in the CRJ100. She held a first class medical certificate issued by the KCAA dated 4 June 2009 with no limitations or restrictions.

According to interview of the first officer and KCAA records, the pilot first began flight training in July 2002. She obtained a commercial pilot license in January 2005 (Australia). In addition to the CRJ100, she has type ratings in Cessna 152, Cessna 172, Piper PA-34, and Cessna 208. She was employed with Jetlink in November 2008 at which time she had about 1200 hours of total time.

According to the first officer's logbook and company records, she had flown about 1,558 hours total flight time, including about 533 hours in the CRJ100/200. She had flown about 74, 10, and 0.3 hours in the previous 30 and 7 days and 24 hours, respectively, before the time of the accident. She received a CRJ100 type rating on 19 February 2009 at which time she had about 1,025 hours of total time including 32 hours of simulator training on the type.

1.6 Airplane Information

The accident airplane, a Bombardier CL-600-2B19, serial number (S/N) 7197 was acquired by Jetlink in June 2007. At the time of the accident, the airplane had accumulated 17,140 total flight hours and 17,025 flight cycles.

At the time of the accident, the airplane was on the first flight of the day. There were no defects recorded in the airplane technical log before the flight. According to information based on the dispatch records, the airplane was within prescribed weight and balance limitations at the time of the accident.

1.6.1 Power-plants

The airplane was equipped with two General Electric (GE) CF34-3A1 turbofan engines. The number 1 (left) engine, s/n 807499, was installed on the airplane on 17 October 2007, and had accumulated about 14,891 total hours and 14,589 total flight cycles since new. The No. 2 (right) engine, s/n 807487was installed on the airplane on 29 September 2009 and had accumulated about 14,897 total hours and 15,357 total cycles since new.

1.6.2 Maintenance Records

The airplane had completed a 3500-hour/500-hour/24-month /16,000-cycle scheduled routine maintenance on 10 November 2009 in Nairobi at the maintenance base. Interviews with company maintenance personnel indicated during the maintenance the number 1 engine was accessed, requiring the opening of the cowling. During the first flight after the maintenance at Jomo Kenyatta (Nairobi) airport, the airplane was involved with a turn back due to a generator problem on the number 1 engine. The discrepancy was resolved and the aircraft returned to service the same day. The aircraft was subsequently operated on six flight segments for a total of 5.2 hours.

On 1 November 2009, the operator hired aircraft maintenance engineers from Europe, one of them was assigned supervisor of the accident aircraft as it underwent the 3500-hour/500-hour/24-month/16,000-cycle routine maintenance in hangar. The engineer agreed to have been responsible for the final inspection of the aircraft but could not tell if the engine cowls were later on opened. The engineer, who last closed the core cowl before the day of the accident, was familiar with stowing and securing the cowl strut. Investigation did not positively determined if the engineer had correctly stowed the cowl strut soon after maintenance.

On a separate occasion during ground test of the left engine after maintenance work was conducted on the fuel control Unit (FCU), a rod of the FCU came loose and the engine became uncontrollable. The engineer (mentioned above), who had not secured the rod prior to ground tests, managed to shut down the engine using fuel shut off valve.

1.6.3 Systems

1.6.3.1 Brake System

Each wheel of the main landing gear is equipped with self-adjusting multi-disc brakes. The brakes of the inboard wheels are powered by number 3 hydraulic system and the brakes of the outboard wheels are powered by number 2 hydraulic system. Number 2 hydraulic system is pressurized by the number 2 engine driven pump and the ACMP. Number 3 hydraulic system is pressurized by an electrical pump. CRJ200 hydraulic design system pressure is 3000 PSI (Pounds per Square Inch).

Brake application is initiated by pressing the rudder pedals which are mechanically linked to the associated brake control valves. The brake control valves meter hydraulic pressure, proportional to the pedal pressure, to the four main wheel brake units, through four independent anti-skid control valves and four hydraulic fuses.

If a leak occurs in a brake line, the associated hydraulic fuse will close off the hydraulic line, preventing loss of the entire system fluid. With the loss of one hydraulic system (system 2 or 3), the aircraft has 50% symmetric braking capability with full anti-skid control to the working brakes. In the event of a failure of both number 2 and number 3 hydraulic systems, accumulators in each hydraulic system will provide reserve pressure for six braking applications (providing the anti-skid is not activated). Available inboard and outboard brake pressure is continuously monitored and displayed on EICAS on the hydraulic synoptic page, and any abnormal brake pressure detected is displayed on the EICAS in the form of a visual and/or aural message.

According to FDR report, the hydraulic system #2 pressure started to reduce as the right engine core spooled down after shut down. This indicates that the #2 hydraulic system pressure was being supplied only by the #2 Engine Driven Pump (EDP). The #2 AC Motor Pump (ACMP) would only come on to provide hydraulic pressure if the ACMP switch was in the auto position AND the flaps were deployed (they were stowed at this time) or the ACMP switch was set to ON (the ACMP switch was set to AUTO).

The rate of reduction of the hydraulic system #2 pressure started to increase rapidly, indicating that there was an increase in hydraulic demand at this time. The system #2 hydraulic pressure was 1500 psi at this point which is less than the threshold for the low pressure warning (1800 psi).

Longitudinal acceleration (Nx) showed a pronounced deceleration of -0.05g which indicates brake application. By this time the system #2 hydraulic pressure was 0. Systems 1 and 3 remained fully pressurized.

The skid marks on the ramp shows there was braking on the right tire as compared to the left tire, which appears to have caused scrapping damage to the tarmac, and it would explain why the airplane turned right during the accident sequence that followed the inadvertent movement of the airplane after it was parked.

1.6.3.2 Parking Brake

Inboard brake control valves and the parking shutoff valve are used to provide braking when the aircraft is parked. Pulling the parking brake handle while fully depressing both rudder pedals and turning the handle 90 degrees in either direction, locks both brake control valves in the applied position. When the hydraulic systems are shut down, hydraulic pressure slowly leaks away via the anti-skid return lines. The parking brake shutoff valve closes when the parking brake is applied, ensuring that hydraulic system 3 accumulator pressure is maintained on the inboard brakes for a prolonged period of time.

The following is noted:

> "*With the parking brake applied, only the inboard brakes will hold for a prolonged period of time if No. 2 and No. 3 hydraulic systems are not available.*"

Parking brake configuration and operational condition are continuously monitored and any detected fault is displayed on EICAS in the form of a visual and/or aural message.

The FDR data indicates that the parking brake remained disengaged after landing for the accident flight.

1.6.3.3 Service Bulletins

During the period from August 2000 to January 2009, Bombardier issued eight service bulletins and revisions thereof for the CRJ-100/200, pertaining to aspects involving the securing of the upper core cowl support strut, including modification of the latching mechanism. A brief summary of each bulletin is as follows:

Effective Date	Number	Reason (Condition)
16 August 2000	CF34-NAC-71-029	Incorrect stowage of the Upper Cowl Door Support Rod may result in the rod working itself free during flight. This can result in possible Engine malfunction.
01 September 2000	601R-71-026	If the support rod for the upper cowl door is not put away correctly, it can fall between the engine fuel – control unit and the throttle control gearbox. The condition can cause an engine malfunction.
03 October 2000	CF34-NAC-71-013	The Hold-open Struts on the Core Cowl Doors can be difficult to engage. To facilitate simpler engagement and ensure correct engagement, new Hold-open Struts are introduced. The new Hold-open Struts have a positive latching mechanism. This Service Bulletin gives rework instructions to replace the struts and associated Hold-Open Bracketry on the Tailpipe, for both left and right installations.
24 April 2001	CF34-NAC-71-013 (revision A)	The Hold-open Struts on the Core Cowl Doors can be difficult to engage. To facilitate simpler engagement and ensure correct engagement, new Hold-open Struts are introduced. The new Hold-open Struts have a positive latching mechanism. This Service Bulletin gives rework instructions to replace the strut and associated Hold-open Bracketry on the Tailpipe, for both left and right installations.
09 May 2002	CF34-NAC-71-013 (revision B)	The Hold-open Struts on the Core Cowl Doors can be difficult to engage. To facilitate simpler engagement and ensure correct engagement, new Hold-open Struts are introduced. The new Hold-open Struts have a positive latching mechanism. This Service Bulletin gives rework instructions to replace the strut and associated Hold-open Bracketry on the Tailpipe, for both left and right installations.
05 February 2004	CF34-NAC-71-013 (revision C)	The Hold-open Struts on the Core Cowl Doors can be difficult to engage. To facilitate simpler engagement and ensure correct engagement, new Hold-open Struts are introduced. The new Hold-open Struts have a positive latching mechanism. This Service Bulletin gives rework instructions to replace the strut and

		associated Hold-open Bracketry on the Tailpipe, for both left and right installations.
05 October 2007	CF34-NAC-71-045	The Retainer Clip and Pin that hold the Strut in the stow position on the Upper Core Cowl Door may wear due to normal vibration of the engine and allow the Strut to work loose. This Service Bulletin instructs the removal of the Retainer Pin and the replacement of the Retainer Clip with a new Spring Clip.
26 January 2009	CF34-NAC-71-045A	Part A: For Operators who have not incorporated the initial issue of this Service Bulletin; The Retainer Clip and Pin that hold the Strut in the stow position on the Upper Core Cowl Door may wear due to normal vibration of the engine. Part A of this Service Bulletin instructs the removal of the Retainer Pin and the replacement of the Retainer Clip with a new Spring Clip. Part B: For operators who have incorporated the initial issue of this Service Bulletin; The Spring Clip installed by the initial issue of this Service Bulletin may not hold the strut securely in the stow position in the event of incorrect engagement of the Strut with the primary locking mechanism. Part B of this Service Bulletin instructs the operator to replace the existing Spring Clip. The new Spring Clip has an improved design that will firmly secure the Strut in the stow position.

1.6.4 Service Difficulty Reports

Transport Canada published eight service difficulty records (SDR) of incidents involving a thrust lever jam (TLJ) of the left engine for the Bombardier CL 600-2B19. The following are summaries of the SDRs.

SDR No.	Date	Description
20040123002	20 December 2003	Shortly after takeoff, the crew noted that left engine throttle could not be retarded from 92%, crew elected to shut engine down with fire/push PBA. Aircraft made an uneventful landing. Subsequent inspection revealed the core support strut had not been properly secured in core cowl with snap retainer and lockpin after last access. When the strut fell down on the engine, it fouled and

		apparently restricted movement of the throttle control box linkage to the fuel control
20041001014	28 September 2004	During a flight after maintenance, aircraft was in climb to FL330 when the throttles were pulled back. Crew was unable to retard left hand engine throttle. Aircraft descended to FL100 where an emergency was declared and the left engine fire shutoff PBA was pushed. An uneventful landing was made. Maintenance found the upper cowl support strut not secured and fouling the fuel control unit lever arm. The aircraft throttle system was checked for damage. Aircraft returned to service.
20051018002 17	5 October 2005	On climb out, attempted to reduce climber power FL250. Captain confirmed the thrust lever was jammed. Complied with the QRH checklist, and declared an emergency. The flight was cleared direct to Memphis (MEM). At thirty miles out and on the ILS 18C, the flight crew shutdown the engine using the fire switch. An otherwise uneventful approach and landing was made. The aircraft was able to taxi to gate and no evacuation of the passengers was necessary. Maintenance found the upper core cowl door stay brace strut had not been properly stowed and that it had jammed the throttle control gearbox. The stay brace strut was properly secured and the aircraft released for flight
20060407001 38	22 February 2006	During climb out, when crew attempted to reduce power, the left engine thrust lever would not move. The crew complied with QRH procedures, declared an emergency and shut down the left engine. Aircraft diverted and performed a single engine landing safely. Maintenance found the left engine cowling stay rod stuck on the throttle control. Removed the stay rod from throttle control and ran the engines. All operational checks were good with no further defects noted. Aircraft returned into service.
20060816008 5	8 August 2008	Flight 5051 – En-route ATL – SAT, the left throttle jammed, crew declared an emergency. Performed in-flight shutdown on the left engine and returned to ATL. Flight landed without incident. Found the cowl hold open support rod loose and binding the throttle control. Re-secured the support rod.
20090321005 7	15 March 2009	The left thrust lever jammed at full thrust. Adjusting friction lock had no effect. Secured engine in-flight in accordance with jammed thrust lever QRH procedure, emergency declared.
20091105001	4 November 2009	On descent, L/H engine power lever could not be retracted. An in-flight shutdown was carried out. Aircraft landed at destination without further incident. Subsequent

		investigation found the left hand engine upper core cowl stay out of place and interfering with the fuel control unit. The spring clip PIP pin holes were found to be worn and a light tapping on the cowling was enough to cause the pin to fall out. The locking mechanism at the end of the say is easily secured improperly and it is undetermined whether the PIP pin was installed in an upwards or downward direction.

1.7 Meteorological Information

The Meteorological Aerodrome Report (METARS) for KGL at 1130 hours was as follows: wind from, 200° at 5 knots, visibility, 10 kilometers or more, clouds and ceiling, 3000 feet scattered, 10,000 feet broken; temperature, 23° C; Dew point, 10° C, Altimeter setting 101.9 mb; Remarks, no significant weather.

1.8 Aids to Navigation

Not applicable

1.9 Communications

The airplane was handled by air traffic controllers from KGL. No communication problems were reported.

1.10 Airport Information

KGL, elevation 4891 feet (1481meters), is served by an air traffic control tower and has a single runway 10/28 with a length of 3500 meters. An apron on the west side is the designated parking area. A building that includes the control tower, offices and a lounge section is located on the west side of the apron. There are two areas for aircraft parking: commercial and General Aviation. Surface Movement Controller (Marshals) provide guidance to aircraft to its parking position

1.11 Flight Recorders

The cockpit voice recorder (CVR) and flight data recorder (FDR) were sent to the National Transportation Safety Board, Washington, DC for readout and evaluation.

1.11.1 Cockpit Voice Recorder

The airplane was equipped with a Fairchild model A200S solid state CVR, serial number 02493, the CVR did not sustain any heat or structural damage, and the audio information was extracted normally and without difficulty.

The CVR contained a 2-channel recording of the last 2 hours of operation and separately contains a 4-channel recording of the last 30 minutes of operation. The 2-hour portion of the recording is comprised of one channel of audio information from the cockpit area microphone (CAM) and one channel that combine two audio sources: the captain's audio panel information and the first officer's audio panel information. The 30 minute portion of the recording contains 4 channels of audio data, one channel for each flight crew, and one channel for the CAM audio information, and a fourth channel for a third crewmember/flight observer. .

1.11.2 Flight Data Recorder

The accident airplane was equipped with an L3 Communications Fairchild model 1000 FDR, S/N 00023058. The FDR was in good condition and the data were extracted normally. While the recorder was an updated version (enhanced FDR), some of the hardware upgrades that accompany this recorder on newer aircraft had not been installed. Sensors for Crew Force Measuring System (CFMS) parameters, such as wheel force, pedal force, brake pedal position individual and brake pressures were not installed on the aircraft so while the recorder was capable, there was no data being supplied for those parameters. About 49 hours of data were recorded on the FDR, including about 12 minutes of data from the accident flight.

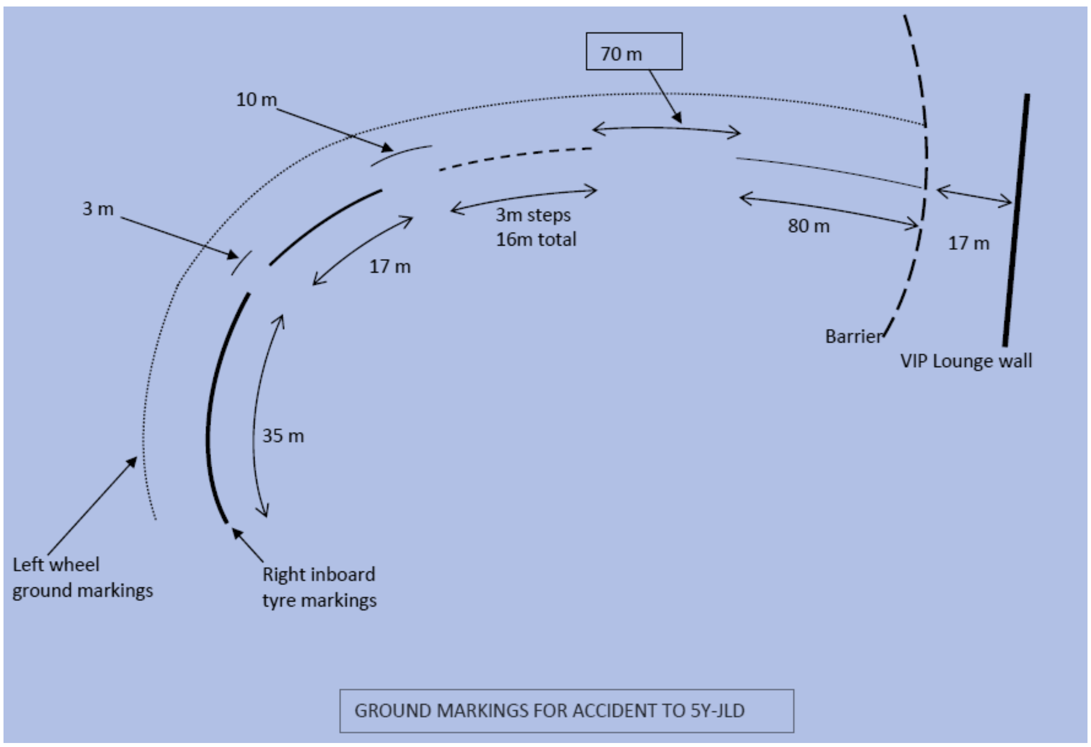
1.12 Wreckage and Impact Information

The airplane, which was generally intact, was located with its front section penetrated through the wall structure of the air traffic control tower building. Along the path on the ramp where the airplane had parked to the accident site was surface damage associated with the landing main gear wheels over a distance of 220 meters that transitioned about 80 degrees from a south to west direction (see Figure 1).

Photo 1. Left rearview of aircraft wreckage

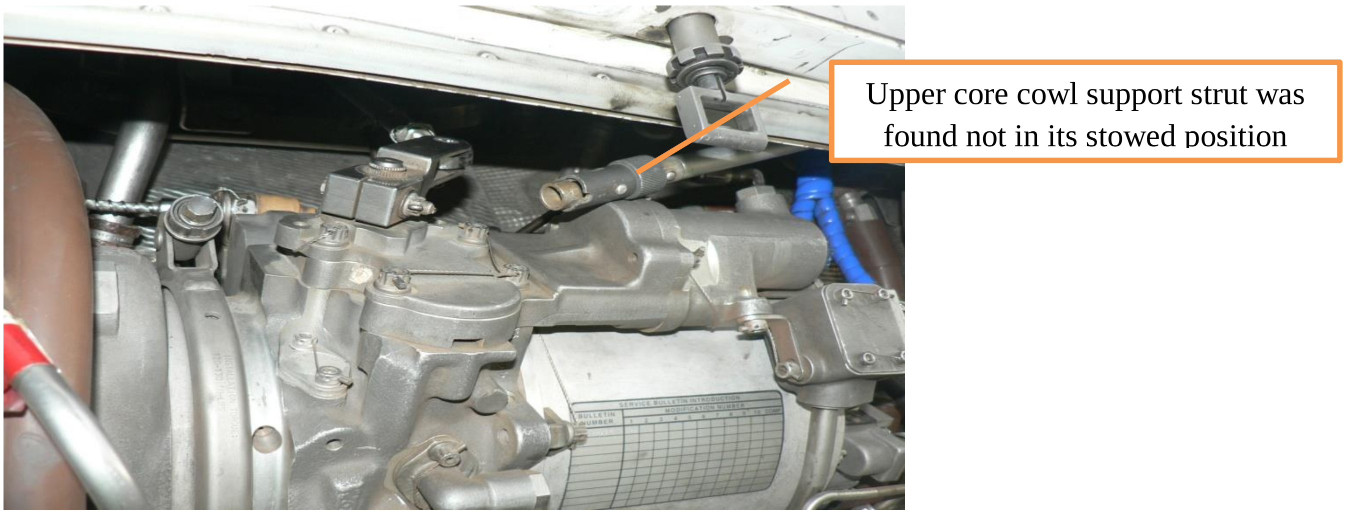
Photo 2. Left side view of aircraft wreckage (above)

Figure 1: Ground Markings (Below)



1.12.1 Engine No. 1

Examination of the left engine revealed the throttle mechanism was in the idle position, the upper core cowl support strut not its stowed position and the safety pin hanging from its lanyard as indicated in number 3 photo below. The strut was in a position to prevent movement of the fuel control unit actuating arm less than the 93% N1. The components of the strut stow assembly, consisting of the locking collar, spring clip, and lock pin were inspected and no evidence of mechanical malfunction was revealed. Continuity was established between the left engine thrust lever and fuel control unit



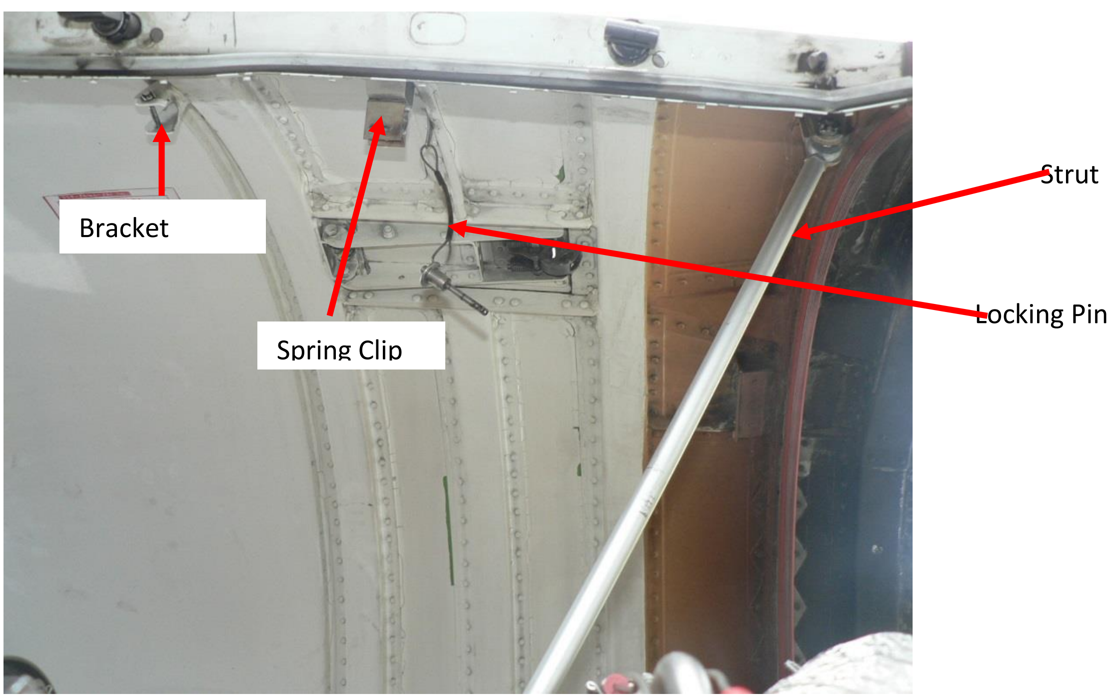


Photo 3. View of Upper Core Cowl Door Hold Open Rod found dislodged.

1.12.2 Parking Brake

Inspection of the parking brake lever indicated that it was pulled up and engaged in the 90 degree locked position, as required for engaging the parking brake.

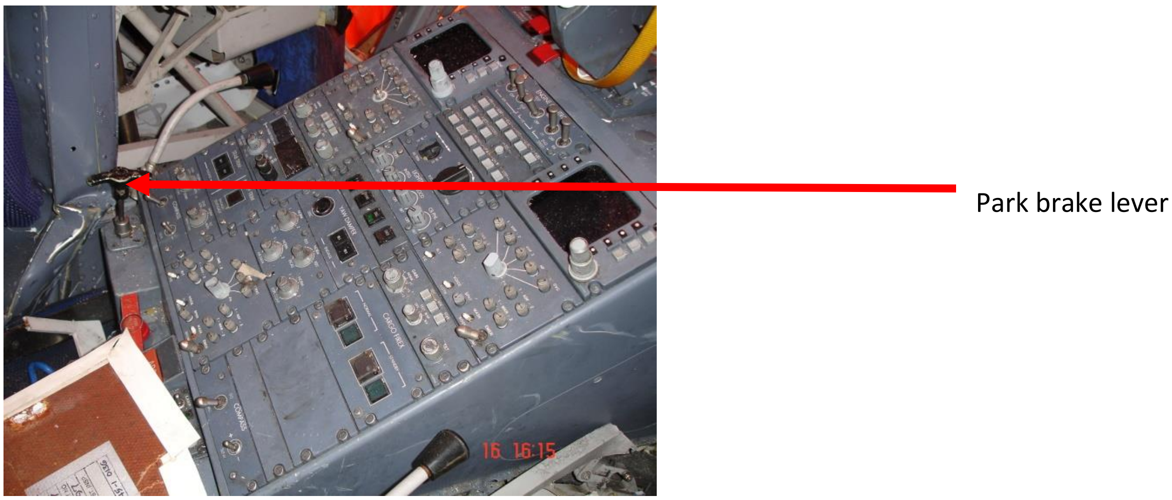


Photo 4. View of Parking Brake in the Park Brake Engaged Position

1.12.3 Main Landing Gear wheels

Onsite inspection showed that the left main landing gear inboard and outboard wheels had deflated. Wheel fuse plugs on both wheels had melted and the outboard wheel indicated evidence of rapturing.

Right main landing gear wheels did not deflate.

1.13 Medical and Pathological Information

1.13.1 Crew

Toxicological testing of the flight crew was not conducted and was considered not a factor in this accident.

1.13.2 Passengers

According to a medical report, a survey conducted on the fatally injured passenger revealed “a deep cut bleeding wound of the scalp that was about 10 centimeters with an underlying fracture of the skull, arterial blood gas showed respiratory acidosis and abdomen ultrasound was unremarkable". The medical report concluded that the cause of death was cardiopulmonary arrest secondary to severe head injury.

1.14 Fire

There was no post impact fire. Fire trucks responded and dowsed the accident site with foam.

1.15 Survival Aspects

1.15.1 General

The fuselage, apart from the cockpit and galley, remained generally intact. Inspection of the seats, seat attachments, and seat restraints did not disclose evidence of malfunction. According to the flight recorder, the vertical acceleration at touchdown peaked 1.75g with minimum lateral acceleration of -0.2g. The minimum recorded longitudinal acceleration recorded was -0.28g.

1.15.2 Cabin

The post impact damage resulted in extensive crushing of the forward fuselage and collapse of the galley area, obstructing the use of the 1L passenger door. The passengers evacuated the airplane through the right hand over wing (RHOW) emergency exit. Several of the passengers exited the airplane with the assistance of the cabin crew.

Photo 5. View of Collapsed Forward Galley

According to the purser, after the airplane first came to a stop in the parking area, the captain informed him that due to the operation of the left engine, that the passengers should be deplaned through the galley door. The purser, in preparation for the exiting of the passenger from the airplane, made a cabin announcement with instructions to unfasten the seat belts and then went to assess the conditions outside the right side of the airplane. Shortly afterwards, the airplane "began to move forward at a fast speed'. Realizing the collision with the building was imminent, he and the ground engineer, who were both standing in the galley area, moved quickly to seat row number one, behind the bulkhead, to brace for the impact that occurred immediately afterwards.

After the airplane came to a stop, the cabin crew with the assistance of the engineer opened both over wing window exits. Due to the operation of the number 1 engine, the passengers were directed through, RHOW exit. After the cabin initial evacuation was completed, the aircraft was reentered by a cabin crewmembers and fire officers, at which time a passenger was found underneath the collapsed galley area. According to cabin crew report, the lady passenger was unconscious and had a weak pulse.

The rescue team together with cabin crew extricated and took the passenger to hospital where according to the surgeon's report, "she was in cardiopulmonary arrest". Primary survey revealed a deep cut bleeding wound of the scalp that was about 10 cm in length with an underlying fracture of the skull. After one (1) hour, resuscitation was stopped and death confirmed.

1.15.3 Cockpit

The flight crew remained in their seats during the impact sequence. The instrument panel was displaced into the occupiable space of the flight crew seats. The captain was partially trapped, and was able to extricate himself. The first officer remained trapped in her seat between the bulkhead behind her and the instrument panel that had collapsed down on her legs, for about 3 hours until she was extricated by rescue personnel.

1.15.4 Rescue Operations

The first responders to the crash site consisted of the fire brigade and air force personnel, among other local officials. Fire brigade smothered the crash site with foam to reduce the risk of fire as a result of fuel leaking from the damaged fuel tanks. The rescue operations included the recovery of the first officer and administering aid to the evacuated aircraft occupants and their transport to local medical facilities. Unsuccessful attempts were made to shut down the operation of the number 1 engine by spraying water into the intake. One of the rescuers, , a helicopter engineer, stated that 'he gained access to the cockpit where he attempted to locate the fire shutoff valves and noticed the left and right throttles were respectively in the maximum and full power positions. He retarded the throttle to the shutdown position and the engine responded accordingly'.

After evacuating all other passengers, rescue officers/cabin crew researched the cabin and found one more passenger (lady) lying unconscious under the collapsed forward galley. The fire officer reported she had a deep cut bleeding from behind the head. The cabin crew noted she had very weak pulse rate. The passenger was stretched out to RCAA airport truck and transported to the hospital.

Resuscitation procedures were immediately commenced and death was confirmed after one hour.

Photo 6. Showing place where one passenger was located.

Ambulance taking the PIC, engineer and other two passengers (white female and white male) got involved in an accident and a pedestrian was fatally injured. Occupants of the ambulance were transferred to other available transport.

Another airline aircraft, which had passengers on board and was close to the crash site, evacuated its passengers to safety.

1.16 Test and Research

1.16.1 Reenactment of Fuel Control lever Jam

A close examination of the core cowl door support strut and locking mechanism was conducted on another operational aircraft. From this analysis, there is evidence that the locking mechanism may not engage properly with a high probability of working itself free in operation. When the strut gets free from its stowed position, it interferes with the fuel control mechanism: the thrust lever becomes jammed at almost full thrust position. A simulation of this scenario resulted in the jamming of the engine thrust lever.

1.17 Organizational and Management Information

1.17.1 . Ground School Training

The training syllabus for Jetlink consist of initial, transition, requalification, and recurrency training. The recurrency training is conducted at 6 months intervals, including ground/simulator training which in part covers aircraft systems, and abnormal/emergency procedures. According to Jetlink company officials, emergency and abnormal procedures were addressed through the training program. However, the training of abnormal procedures was done in stages over 24 months. During this 24 months period, the subject procedure for Thrust Lever Jammed (TLJ) was to be covered in the later stage. In regards to the accident flight crew, the TLJ procedure had not been covered.

1.17.2 Flight Manual

The current Aircraft Flight Manual, Flight Crew Operating Manual and Quick Reference Handbook each has as section identified the procedure for a Thrust Lever Jammed and categorized as an Abnormal Procedure. The first step indicated in each of the documents that following safe altitude before commencing the approach is the selection of the “ENG FIRE PUSH” (high pressure fuel cutoff).

1.18 Additional Information

1.18.1 ICAO Standards

Annex 8 to the Convention on International Civil Aviation Part 1 Chapter 4 - Systems design features states -‘Special consideration shall be given to design features that affect the ability of the flight crew to maintain controlled flight. This shall include at least the following:

a) *Controls and control systems.* The design of the controls and control systems shall be such as to minimize the possibility of jamming, inadvertent operations, and unintentional engagement of control surface locking devices.’

1.18.2 Corrective Actions

1.18.2.1 Jetlink

Notices were issued separately to the pilots and the aircraft maintenance engineers on 18 November 2009. The notice to the pilots, in part, denoted that preliminary findings disclosed a jammed left thrust lever and made reference to the AFM to find the complete procedure to address the anomaly**.**

1.18.2.2 Transportation Safety Board of Canada

The Transportation Safety Board (TSB) of Canada issued Aviation Safety Advisory A09F0163-D1-A1 to Transport Canada regarding Service Bulleting Implementation: Interference of Upper Core Cowl Door Stay Brace Strut/Rod with CF34-3 Engine Throttle Mechanism

1.18.2.3 Bombardier

Service Bulletins CF34-NAC-71-056 and 601R-71-033 were issued respectively on 18 July 2011 and 24 August 2011 addressing the stowing of the upper core cowl door hold open rod in a specified time period.

1.18.2.4 Transport Canada

Airworthiness Directive CF-2011-38 was issued on 10 November 2011 requiring the accomplishment of Bombardier SB 601R-71-033.

2 ANALYSIS

2.1 General

The flightcrew was properly certificated and there were no stated medical conditions in their licenses preventing them from performing their flight duties. The airplane was properly certificated and maintained, and apart from the disengagement of the cowl core door support shaft, the aircraft was in a mechanical condition capable to conduct the flight. Weather was not factor. The analysis will discuss the circumstance of the cowl door support unlatching and the flight crew performance in response to the mechanical defect.

2.2 Accident Sequence

2.2.1 Takeoff

The TLJ condition was noticed by the flightcrew early in the takeoff phase and the PIC decided to discontinue the flight to the destination, to take steps to resolve the problem and the consequential abnormal flight performance. However, flightcrew 's lack of discipline to complying with standard procedures under the conditions, lack of understanding of the engine systems, failure to consult with company operational and maintenance personal, and overall poor judgment resulted in their not being able to identify the appropriate action. Consequently, the aircraft performance remained in an undesired state with the number 1 engine at an improper power setting for landing and during ground operations. The inadequate flightcrew actions resulted in an escalation of a single abnormal condition to a cascading of non-normal conditions together with an increase in workload and task saturation.

Despite the flightcrew mishandling of the TLJ, they commendably were able to land the airplane under a most abnormal condition.

2.2.2 Ground Operation

The increased power setting on the number 1 engine during the landing required extra braking resulting in hot brakes. The flightcrew was aware of the problem, but did not fully recognize the consequences of the conditions if not remedied. As was the case in the air, the flightcrew deviated from procedures when a non-normal condition was encountered, together with the false sense that the level of threat to safety had been significantly reduced, resulted in the brake operation continuing. The application of brakes during taxi only aggravated the hot brakes of which apparently the flightcrew did not fully realize the degree of safety hazard that existed.

Under normal circumstances, the captain should have reported the situation to ATC and follow airplane flight manual and airport procedures for hot brakes which would have involved firefighting personnel at the time. However, the no 1 engine power setting made avoidance of the use of the brakes impracticable. Therefore Flightcrew's failure to shut down the number 1 engine and continuing inability to allow a correctable condition to persist were the sources of the succeeding hazards.

Although the PIC succeeded with bringing the airplane to a stop, he understandably became focused on the evacuation of the airplane and shutting down the number 1 engine. Consequently, his lack of understanding of the brake system and the associated non-normal condition resulted in a degradation of the braking capabilities. The captain’s lack of comprehension of the deterioration and his concern about the number 1 engine resulted in communication with the cabin attendant that invariably resulted in instructions to the passengers to unfasten their seatbelt, placing them in a hazardous condition, which in the case was probably not foreseeable. The crew was concerned with the safety of the passengers by their quick exiting of the airplane and the decision to release the seatbelts was not unreasonable

The loss of capability of the airplane to remain parked can be attributed to either one or a combination of the following events: deflation of the tire due to rupture/ melting of the wheel fuses and the loss of adequate hydraulic pressure to provide sufficient parking braking. The rupture of the tire and the melting of the wheel fuse plug would have been a direct result of the hot brakes as the over-temperatures exceeded the limits to maintain the mechanical integrity of the components causing the loss of sufficient ground traction. The loss of hydraulic pressure as a result of the shutdown of the number 2 engine, which occurred before the airplane was parked, resulted in the loss of brake pressure to the outboard brakes. The airplane swerved to the right during its uncommanded movement before it struck the building. The action is consistent with the loss of ground traction, and the absence of skid marks, from the left inside tire, as evident by the deflated left inside tire, and the application of brakes on the right tire due the availability of only hydraulic system number 1 as exhibited by the associated skid marks.

The passengers were unrestrained when the airplane abruptly traveled across the ramp from the park position. The announcement to the passengers to unfasten the seat belts would have given the passengers that it was safe to become unseated in anticipation of exiting the airplane. Therefore many of the passengers were probably standing at the outset of the sudden movement of the airplane from being parked. The passengers, especially those who were standing would have been displaced by forces associated with the acceleration and deceleration with the respective movement across the ramp and the collision with the barriers and building, and its probable the foregoing sequence attributed directly to the injuries that were sustained by the occupants in the cabin. Consistent with the surgeon’s forensic determination of the fatal injuries to the passenger, rescuers statements, the collapsed structure of which she was subject increased the severity of the incurred injuries.

2.3 Core Cowl Door Support Shaft

The aircraft had been operated for 4.6 hours, and completed 6 flight segments since it had undergone scheduled maintenance. The number 1 engine core cowl door had not been opened since the maintenance. There were no deficiencies reported involving the operation of the thrust lever for the number 1 engine. It is suspected maintenance crew did not correctly stow the cowl strut after performing maintenance and due to engine vibrations, could have moved and interfered with engine throttle mechanism. Therefore, the cowl strut interference probably occurred during the takeoff phase of the accident flight, most likely shortly before the TLJ was noticed by the flightcrew.

The company operational personnel were not familiar with the service bulletin or history of in-flight incidents involving the cowl core door support shaft mechanism. The maintenance personnel, including those who were last involved with the closing the cowl door, were knowledgeable of the correct latching procedure. There was no indication that the procedure was not followed when the cowl door was last used.

The support shaft stow mechanism had been the subject of several service bulletins requiring its modification. The aircraft manufacture considers the jam of one engine throttle during flight a low risk as the manufacturer has provided a mitigating procedure in both the Aircraft Flight Manual and FCOM. The service bulletins were specified as discretionary for compliance except one recommended service bulletin number 601R-71-026. Although there were indications of compliance to the earlier service bulletins, the one in effect at the time of the accident had not been complied with. Further, several incidents had occurred before this accident were attributed to the core cowl door support strut interfering with left engine throttle mechanism. Given the possible failure by maintenance crew to stow the core cowl support strut correctly and mechanism susceptibility to interfere with throttle mechanism in its unstowed position, it is most probable that the incorrectly stowed core cowl support strut interfered with the throttle mechanism above 93% NI speed during takeoff resulting in the engine number 1 throttle jam.

The company lack of familiarity with the history of the cowl door support shaft stow mechanism was a combination of its maintenance program that did not require mandatory compliance of all service bulletins, not availing itself to safety literature that would have alerted of the problem, and the manufacturer's classification of the service bulletin as low risk that resulted in undervaluing the level of risk associated with the condition.

2.4 Braking System

The physical evidence clearly showed the left tires deflated. The captain's statement indicated the deflation occurred during the landing, which is quite possible considering the excessive braking that would have been needed to stop the airplane. Also, the brake overheat warning alerted several times after the landing, which also could have resulted in a deflation of the tires if the heat migrated to the heat fuses installed to prevent an explosive deflation. In any case, the tire was probably deflated before the aircraft inadvertently moved forward after it was parked.

As the aircraft started moving forward from the parked position, the rate of reduction of the hydraulic system #2 pressure started to increase rapidly, indicating that there was an increase in hydraulic demand at this time, a scenario that is consistent with brake application. The system #2 hydraulic pressure was 1500 psi at this point which is less than the threshold for the low pressure warning (1800 psi) however this bit is inhibited on-ground and it did not activate.

2.4.1 Park Brake

There is no written text from either one of the pilots that specifically addresses whether or not the parking brake was used. Therefore, there is conflicting information of which one source is based on physical evidence and the other source is recorded data. Regarding the position of the parking brake, it is quite possible that it could have been displaced up by the displacement of the instrument panel rearward due to the impact forces. However, it is not conceivable, if at all possible, that the impact forces would provide a twisting or torque force needed to turn the handle 90 degrees to engage the handle. This evidence, notwithstanding the FDR data, suggests the parking brake handle was in the engaged position prior to impact. Nonetheless, whether or not the parking brake was engaged is inconsequential because after the tire deflated, the rolling traction no longer existed for the brake pressure to resist. Consequently, the left tires would have been mostly dragged across the ramp instead of being in a normal condition to resist rolling by the brakes.

According to the captain's statement, the tire deflated during landing. In addition, the overheat brake condition that existed after the landing would have potentially resulted in a deflation of the tire as the airplane was taxied after the landing or while it was parked. The parking brake was found in the engaged position, which appears to be a pre-impact position the required 90 degree rotation of the handle that would have been not attributed to the impact forces. The investigation was not able to reconcile whether the parking brake was engaged. However, the parking brake status would have been inconsequential because the deflated left tire would not have able to resist motion as it would have if it was intact and inflated. Therefore, after the aircraft was parked, it was probable that the friction force from the deflated tires was exceeded by the thrust of the right engine. According to the FDR evaluation, as the airplane traveled during the inadvertent movement, braking pressure was applied, consistent with the skid marks due to the heavy braking from the right tire. The extent that the parking brake system contributed, if at all, to prevent the airplane from moving while it was parked or from resisting its movement afterwards was not determined.

2.5 Systems Design Features

The support shaft stow mechanism had been the subject of several service bulletins requiring its modification. The design of the engine control systems allows interference with the left engine throttle mechanism whenever the core cowl support strut is not in its stowed position. Bombardier service bulletins, which were specified as discretionary for compliance, were focused to “minimize” the possibility of jamming. The aircraft manufacture considers the jam of one engine throttle during flight a low risk as the manufacturer has provided a mitigating procedure in both the Aircraft Flight Manual and FCOM.

At the time of the accident, the State of Design, (Authorities that type certificated the aircraft) had not issued an Airworthiness Directive to address this unsafe condition.

2.6 Organizational and Management Information

The investigation determined that the emergency and abnormal procedures were addressed through the training program over a period of 24 months. The crew had not yet received training of abnormal procedures during their most recurrency training conducted at 6 months intervals, of which the subject procedure for Thrust Lever Jammed (TLJ) was included.

The PIC got hired by the operator beginning of 2009, obtained CRJ100 rating on 9 March 2009 and was released to PIC upgrade on 24 March 2009 before completing all abnormal procedures.

2.6.1 Crew Training Program

Based on inconsistencies and deficiencies noted in crew training and upgrading systems, the investigation concluded that the training program was not comprehensive and the upgrading system appeared to be rushed without thorough prior assessment of individuals. PIC was upgraded prior to completion of training on all abnormal procedures.

3 Conclusions

3.1 Findings

3.1.1 The flight crew was certificated, and experienced in accordance with applicable air regulations, but was not fully competent as it;

3.1.1.1 Lacked knowledge and understanding to shut down number one engine using the FIRE/PUSH button,

3.1.1.2 Failed to consult with company operational and maintenance personnel on ground,

3.1.1.3 Lacked discipline to comply with standard operating procedures by not referring to the aircraft flight manual, flight crew operating procedures, quick reference handbook which were available in the cockpit resulting in their inability to adequately respond to abnormal situation and therefore increased the operational risk in managing the jammed thrust lever,

3.1.1.4 Lacked understanding of the brake system and the associated non-normal condition resulted in degradation of the braking capabilities of the aircraft,

3.1.1.5 Decided to tax the aircraft with one engine operating at 93% power and overheated brakes into terminal parking area rather than following AFM and evacuating the aircraft on the runway.

3.1.2 The airplane was certificated and maintained in accordance with applicable regulations.

3.1.2.1 Jetlink operational and maintenance personnel who last serviced the aircraft were not aware of the service bulletins involving the core cowl door support shaft.

3.1.3 The weather was not a factor.

3.1.4 The core strut, which was found in the not stowed position, interfered with the left engine throttle lever during takeoff resulting in a jammed thrust lever.

3.1.5 The aircraft was operated for 4.6 hours and 6 flight legs since the number 1 engine was last accessed. It is suspected maintenance crew did not correctly stow the cowl strut after performing maintenance and due to engine vibrations, the unsecured core cowl support strut could have moved and interfered with engine throttle mechanism.

3.1.6 The design feature of the left engine upper core cowl support in relation to the engine throttle mechanism is a safety hazard as it is prone to interfering with the engine throttle mechanism whenever it is in its unsecured position. The aircraft design organization mitigated the risk by conducting several discretionary modifications (except one recommended service bulletin number 601R-71-026) and providing a TLJ (Throttle Lever Jammed) procedure in the aircraft flight manual, flight crew operating manual QRH.

3.1.6.1 State of Registry regulations, at the time of the accident, did not mandate embodiment of discretional or recommended service bulletins. The regulations require compliance with any Airworthiness Directives issued by the State of Design or service bulletins identified by the Manufacturer as mandatory. The Operator approved maintenance procedures did not required compliance with discretionary or recommended service bulletins, but required compliance with Airworthiness Directives or service bulletins identified by the Manufacturer as mandatory.

3.1.6.2 At the time of the accident, there was no Airworthiness Directive issued by State of Design or any one of the Authorities that type certificated the aircraft to correct an unsafe condition existing on engine number 1 upper core cowl shaft and fuel control system.

3.1.7 The aircraft was landed in an undesired state, which required heavy braking during the landing and continued application of brakes during taxing and when it was parked.

3.1.8 The overheated brakes melted the fuse plugs of both left main landing gear wheels deflating the inboard wheel while the outboard wheel was suspected to have deflated from either a melted wheel fuse plug or rupture.

3.1.9 The combination of high power from number 1 engine, deflation of the left inside tire, and brake pressure applied to the right inside tire resulted in the abrupt acceleration and right turning movement over a distance of about 148 meters until the aircraft struck jet blast barrier and tower building.

3.1.10 Passengers, both unseated and seated with unfastened seat belts, were subjected to the acceleration and deceleration forces from the aircraft movement from its parked position and the impact sequence with the jet blast barrier and air traffic control building attributed to the severity of the injuries.

3.1.11 There were several CRJ 100/200 incidents involving thrust lever jam of which the number 1 engine was shut down by the flight crew pressing the FIRE/PUSH button followed by successful single engine landing.

3.1.12 Jetlink training for all abnormal procedures was conducted progressively in a 24 month period that incorporated in the initial/recurrency training. The accident pilots, who each had been employed for less than 3 years, had not been exposed to the TLJ procedure in their training. The TLJ procedure was to have been covered in the latter stages of the program.

3.1.13 Jetlink, Bombardier, TSB, and Transport Canada implemented corrective actions following the accident.

3.2 Probable Cause

The flight crew's failure to identify corrective action and their lack of knowledge of applicable airplane and engine systems in response to a jammed thrust lever, which resulted in the number 1 engine operating at high power and the airplane configured in an unsafe condition that led to the need to apply heavy braking during landing. Also causal was the flightcrew failure to recognize the safety hazard that existed from overheated brakes and the potential consequence on the braking action needed to park the airplane. Contributing factors included the possible failure by maintenance crew to correctly stow the upper core cowl support strut after maintenance, Flightcrew's failure to follow standard operating procedures, the company's failure to be availed to manufacturer safety literature on the subject, and the susceptibility of the cowl core support shaft to interfere with the throttle control mechanism when the core strut is not in its stowed position.

4 Recommendations

4.1 In order to ensure flight crew members are adequately equipped with knowledge and skills critical to handle abnormal and emergency situations, States of Registry and operators should ensure that addition of a rating or upgrading to captaincy is done when the incumbent completes an initial training program covering at least all abnormal and emergency procedures.

4.2 Operator Safety Management Systems should be enhanced to include scanning for safety related information from the manufacturer and other sources and ensure effective sharing of information throughout the organization.