*International Civil Aviation Organization*
CAR/SAM Regional Planning and Implementation Group (GREPECAS)
**Ninth Meeting of the GREPECAS Aeronautical Meteorology Subgroup (AERMETSG/9)**
Lima, Perú, 23 to 27 June 2008

**Agenda Item 11: Any other business**

## Too many Accidents with the same cause

(Presented by the Secretariat)

**Summary**

The purpose of this information paper is to present the article titled *"Too many Accidents with the same cause"* of the *"Aviador"* magazine of the Official School of Commercial Aviation Pilots (COPAC).

1. **Introduction**

1.1 **Appendix A** to this information paper presents the article titled *"Too many Accidents with the same cause"* published by the *"AVIADOR"* magazine of the Official School of Commercial Aviation Pilots (COPAC) of Spain, in its edition No. 45 of March-April 2008. COPAC kindly authorized to publish this information in the meeting.

**APPENDIX A**

# Analysis of the Air France A 340-313 accident at the airport of Toronto/Lester B. Pearson on 2 August 2005

## Too Many Accidents with the Same Cause

**Francisco Cruz. COPAC**

The report of the accident that we are going to analyze, made public in December 2007 by the Canadian Transportation Safety Board (TSB), confirms the chief of many recent accidents: intent of approach and landing in stormy conditions at the airport of destiny, when the most recommendable thing would have been to wait for the weather to improve or to deviate an alternative airport. In this analysis we will concentrate on the development of the flight, the causes of the accident and, above all, the risks found by the TSB and the recommendations of safety emitted by the Canadian agency extensive to operators and aeronautic authorities.

### The dispatch of the flight AFR 358 in Charles de Gaulle (CDG)

In Air France (AF) for long haul flights the presentation which makes itself 1h 45 minutes before departure. The crew goes to a briefing room where one delivers a folder with documentation of the flight. In this room the co-pilot and the commander (in this flight there are only two pilots) make the dispatch of the flight without a dispatcher being present who may be called in case a clarification is needed. Once the documentation is analyzed, the pilots meet with the TCP and give a briefing covering all the operational aspects: security, rescue, weather of route, forecasts etc.

The operational flight plan is calculated by an information system that chooses the alternative airport for reasons of proximity, without bearing in mind the meteorological weather in said field. In this flight the system chose Niagara Falls (KIAG). Given the stormy conditions that prevailed in Toronto the commander decided to put 3000 kg of fuel, that given the quantity burned would have been a supposed 2250 Kgs. of extra fuel to arrive to the destination (23 minutes of holding in Toronto).

### Takeoff and cruise

The commander made the functions of PF (Pilot Flying) in the first half of the flight and in the second half changed the functions, leaving the co-pilot as PF and the commander as Pilot Monitoring (PM) for the approach and landing in Toronto. The flight left with 297 passengers, 10 TCP and 2 pilots.
The take-off and taxi at departure were normal. Now in route, the oceanic ATC changed the track and they could not climb beyond FL350 during the entire crossing of the Atlantic, due to the AF information system that calculates the routes of minimum time and makes it equal for all flights that leave at the same time (CDG is the main hub of AF). This causes it to

frequently occupy the optimum level for other airplanes of the company that leave to the same time. For this reason the flight made a different route at a lower level.
On route the crew was conscious of the meteorological changes in Toronto and in the alternative airports predicted through various ACARS messages. Given the meteorology of Toronto (CYYZ) and of the planned alternative to Niagara Falls (KIAG), both with storms, the pilots decided to change the alternative route to Ottawa (CYOW). At 19:04 they send a message to AF operations indicating that in case of missed approach they should proceed to Ottawa. With Ottawa as alternative, the crew had calculated 7.3 tons of fuel to proceed to said airport, leaving 14 min of fuel oil extra for holding in Toronto.

**Descent and approach, hours in UTC (local Time in Toronto UTC-4)**

- 19:15, ATC gives instructions to the flight AFR 358 to reduce its speed due to delays in Toronto.
- 19:19, the crew revises the procedure of windshear.
- 19:28, AFR 358 is authorized to the STAR Simcoe 2. The remaining fuel was 9.3 tons.
- 19:30, the crew revises the company policy on when to declare minimum fuel. According to the manual of AF, if the predicted quantity on arrival at destiny is lower than 1.5 times the final fuel reserves, the crew should declare "minimum fuel" to ATC. If the fuel were lower than the final reserve, in this case 2800 Kgs would be treated as an emergency.
  If the crew had chosen to divert to Ottawa after a missed approach in Toronto, they would have had to declare "minimum fuel". If there was supposedly a delay due to traffic (many companies had this alternative one) it is probable that the crew would have had to declare an emergency of fuel.
- 19:33, the information emitted by the ATIS indicated that the visibility had reduced in Toronto because of strong rainfall due to the storms. The runway 24 L was expected for the landing, with a Landing Distance Available (LDA) of 9000ft. (2743mts.)
- 19:36-19:40 a briefing was carried out for the approach ILS of runway 24L. In the briefing no mention was made of the longitude of the runway or of the procedure of missed approach. Furthermore, the calculations of landing distance for the wet runway or contaminated were not made.
- 19:40, some airplanes in that same frequency were required to proceed to their alternative airports.
- 19:53, AFR 358 was the third for approach. The two airplanes in front of AFR 358 landed without consequences.
- 19:58, AFR 358 was stabilized in the final approach. The airplane preceding had reported action of poor braking; the wind instruments of the tower (TWR) were not working because it had damaged itself during the storm. The last available wind of the TWR was 230 degrees/7Kts. and had lightnings around the airport. The autobrake was selected to MEDIUM (it has 3 positions: LOW, MEDIUM AND MAX). The regional jet that preceded the AFR 358 reported wind of 290 degrees from 15 to 20 knots and action of poor braking until the aircraft decelerated below 60 knots. The meteorological conditions during the remainder of the approach varied between IMC to VMC with turbulence and strong rainfall. AFR 358 had visual contact with the terrain when the plane was at 3 NM of the runway. The runway was covered with water and lightnings from both sides and at the end of the runway. The automatic pilot (AP) and automatic gases (ATHR, autothrust) were connected, and the plane

was stabilized to a speed of approach Vapp of 140 Kts. To 323 ft. AGL the PF disconnected the AP and 2 seconds later the ATHR. The PF then incremented the thrust of 42% of N1 to 82% of N1 because he felt the speed descended and the aircraft itself was sinking. The plane then began to deviate from its glide path. Just in that instant the wind changed from a cross component to a tail component, up to 10 knots.

**The landing**

The plane crossed the threshold at 40 feet above the glide path. Just then the plane entered an area of hard rain and visual contact with the runway was reduced to a considerable form. The PF started the flare when it was approximately 40 feet above the runway. From that instant there are numerous inputs in the sidestick, the plane remained leveled to a height of 25 feet AGL during a period of 2.5 seconds. The PF began a progressive reduction of power since a 76% of N1 when the plane was at 50 feet, with the thrust levers reaching position IDLE when the plane was 20 feet AGL. The plane touched ground with the runway 24L (LDA 9000 Ft) to 3800 Ft and passed the threshold. The spoilers had deployed themselves automatically, then the two pilots immediately applied manual braking and tried to align the plane with the center of the runway. The reverse in IDLE was selected 12.8 seconds after touchdown and the maximum reverse power was selected 16.4 after touchdown. The call-out standards to indicate deployment of the spoilers and of the reverse were not done on part of the Pilot Monitoring. The plane left by the end of runway to an approximate speed of 86 kts. and stopped in a ravine. During the approach and the landing no notices were generated of detection or of prediction of windshear.

**The evacuation**

When the aircraft stopped the purser, whom was at the front part of the plane, removed the belts and harnesses and caught the PA from the floor. From that position he was not conscious of the smoke and fire or that there were passengers in the walkways heading towards the emergency exits. All that was announced was: "Everything is OK, remain seated, the crew will look after you". The TCP that was in position L2 approached the purser and reported to him that there was fire in door L33 and that an evacuation was necessary. The purser communicated this to the commander, whom was injured upon being removing his seat from the floor, and activated the evacuation warning pressing EVAC ON, but the system did not work the same as the PA.
Approximately 2/3 of the passengers were evacuated by the exit R4. The remainder of the passengers was evacuated via L1, R1 and R2 or a few by the exits L2 and R3. The evacuation was carried out in conditions of hard rain and in less than 2 minutes. Many passengers took their luggage, which complicated the evacuation and represented a serious risk.

**Analysis of the causes and contributing factors of the accident**

All the plane's braking systems functioned correctly and the TSB determined causes and contributive factors of the accident as the following:

- The crew carried out an approach and landing in the middle of a severe and dynamic storm. In AF there were no clear procedures related to the distance required for

approaches and landings in stormy conditions.

- After the disconnection of the AP and ATHR, the PF increased the power in reaction to a decrease of speed and a perception that the plane was sinking. This increased power contributed to the plane's deviation above the glide path.
- At 300 ft. AGL, the wind surface changed to have a component of 10 kts. tailwind. This caused the plane to cross the threshold of the runway between 70 and 80 feet (it is normally 50 ft.).
- Upon approaching the threshold, the plane entered a zone of hard rain intensity that reduced the visibility.
- When the plane was near the threshold, the pilots became stubborn during landing and believed that the option of 'Go Around' was no longer possible.
- The touchdown was long due to the excess of power that caused that the plane to float and to the loss of visual references on account of rain.
- The plane touchdown was at 3800 ft, leaving 5200 ft. of available runway for the plane to stop. According to the manuals of AF the necessary distance for landing in Toronto on a contaminated runway, from 3 to 6 mms of water, and without reverse was of 8780 ft. For runway 24L, this extra margin was only 220 ft (RWY 24 L LDA 9000 ft). The weight at the moment of the landing was 185 tons.
- Due to the flotation in the landing this margin no longer existed. With wind at tail the margin is negative, which signifies an overrun. According to the Airbus Flight Crew Training Manual, to pass the runway at 100 ft instead of 50 ft increases the distance of landing in 950 ft (300 m). The pilots were not conscious at any moment that the distance of landing with wind at tail was over the distance of landing available for those conditions of the runway.
- The selection of reverse and its maximum power was done with certain delay.
- The Pilot Monitoring did not make CALL OUT standards relative to the spoilers and to the reverses during the landing. This contributed to the PF's delay in the application of maximum power of reverse.
- Due to the fact the runway was contaminated by water, the force of wind at 19 Kts. made them exceed the limitations of landing the plane.

**TABLA 1. RELEVANT FLIGHT DATA RECORDER INFORMATION**

| **Position** | **FDR Recorded Winds** | **Calculated Wind** | **Tailwind Along Runway Axis** | **Crosswind Across Runway Axis** |
|---|---|---|---|---|
| Autothrust disconnect | | 327º M/ 15 knots | -1 knot | 15 knots |
| Threshold crossing | | 004º M/ 22 knots | 12 knots | 18 knots |
| Touchdown | 330º T/ 11 knots | 005º M/ 24 knots | 12 knots | 19 knots |
| Reverse selection | | 360º M/ 20 knots | 10 knots | 16 knots |
| End of runway | | 355º M/ 21 knots | 10 knots | 18 knots |

## TABLA 2. SUMMARY OF WEATHER

| **Time (UTC)** | **Time Prior to Landing** | **CYYZ Weather Information** |
|---|---|---|
| Pre-flight | | TAF CYYZ 0539 z 06-06 280@10 P6SM SCT 40 FM 17Z VARIABLE@3 P6SM –SHRA BKN 30 PROB 30 17-22 2SM TSRA BKN CB 20 FM 22Z 300@8 P6SM BKN 30 RMK NEXT FCST BY 09 Z |
| 1444 | 5 hr 18 min | METAR 14Z CYYZ Wind 360@4 15 SM 35 FEW 260 FEW 28/19 30.07 REMARK CU, CI |
| 1608 | 3 hr 54 min | AFR 358 received ATIS J (with 1600 CYYZ weather) via ACARS. ATIS JULLIET- 16Z 360@5 15 SM SCT 45 SCT 120 SCT 260 30/20 30.04 |
| 1811 | 1 hr 51 min | METAR CYYZ 18Z 120@2 8 SM –TSRA SCT TCU 35 BKN 90 23/22 30.03 RECENT RAIN RMK TCU 3 AC3 CB ASOCTD |
| 1913 | 0 hr 49 min | AFR 358 inquires if ATC has info about movement of system- believes it is going from north to south. ATC advises weather seems to be moving east |
| 1915 | 0 hr 47 min | AFR 358 told of delays in Toronto- requests heading deviation due to weather |
| 1917 | 0 hr 45 min | METAR CYYZ 19Z 220@07 4 SM +TSRA BKN 05 TCU BKN 080 24/23 A 30.03 RMK TCU 6 AC1 CB ASSOCTD |
| 1922 | 0 hr 40 min | ATC advises AFR 358 traffic is starting to move into Toronto |
| 1933 | 0 hr 29 min | AFR 358 received ATIS Uniform via ACARS<br>AFR 358 received METAR reports for KCLE, CYOW, and KIAG via ACARS |
| 1940 | 0 hr 22 min | AFR 358 asks ATC if weather is worsening in Toronto<br>ATC advises able to send aircraft in now but not sure about later<br>AFR 358 asks to be kept advised as they may have to “deviate” |
| 1944 | 0 hr 18 min | AFR 358 asks to be kept advised of worsening weather-<br>ATC says will advise of weather |
| 1949 | 0 hr 13 min | AFR 358 requests deviation left to avoid weather |
| 1953 | 0 hr 09 min | Controller asks JZA 8677 if they think they will get the field. Aircraft advises is to the north and looking pretty bad |
| 1959 | 0 hr 03 min | Tower advises AFR 358 that:<br>2 previous aircraft reported braking action “poor”<br>Wind instruments knocked out by thunderstorm-last report was 230@7 kt<br>Lightning activity all around the airport |
| 2000 | 0 hr 02 min | Tower advises aircraft just landed reported wind at 290@15G20 kt<br>Tower advises that RJ in front reported braking “poor” until slowed below60 kt and clears AFR 358 to land<br>Nota: El accidente ocurrió a las 2002 UTC |

**Risks, recommendations of safety and actions of the operator after the accident**

The investigation of the accident permitted the TSB to highlight the following risks; to those that associated an action required as much operators as aeronautic authorities:

- Absence of clear guides with regards to approaches and landings in stormy conditions. There is a great probability that crews continue doing approaches in these conditions, increasing the risk of an accident. Therefore, it is recommended that the operators establish some clear guides limiting the approaches and landings in stormy weather. Also it is recommended to give training to pilots to take better decisions in these conditions. Air France has revised its manuals of operation and public guides more clearly for its crews.
- For approaches in meteorological conditions of storms, pilots can be misled to think that the ATC will suggest if it is convenient to land or not. Some pilots are under the impression that the ATC will close the airport if meteorological conditions make the landing unsafe, but the ATC does not have that authority. Therefore, it is recommended that the aeronautic authorities establish clear guides limiting the approach and the landing in meteorological conditions with storms.
- Although it wasn't determined that the RAIN REPELLENT had increased the visibility during the downfall, the crew didn't have adequate information on the capacities and operation of the rain repellent and did not consider its use. Air France had provided more information on the system and in September 2005 emitted a technical note, which indicated to the pilots that there was no restriction of use for the RAIN REPELLENT in any plane condition.
- A policy where only the captain may take the decision to make a missed approach can increase the possibility that an unsafe situation is not recognized in time. After the accident, Air France changed its policy so that both the commander and co-pilot can decide on how to carry out a missed approach.
- The supply of emergency energy as much for the PA as the EVAC COMMAND is located in the electronic compartment of the plane. A system less vulnerable or localization could reduce the risk that these systems fail again in a similar accident.
- There are no visual signs that some ramps of double channel have two channels. This caused the ramps to be used like those of a single channel, which slowed down the evacuation. One may comment that the availability of three more assistants on flight AFR 358 (10 in total) had contributed to the evacuation being developed in a successful way.
- Although all the passengers managed to evacuate the plane, this was complicated by the circumstance that near 50% of the passengers carried their hand baggage. It is recommended in the safety briefings for the passenger (video, pamphlets, TCP guides, etc) and is included in a clear form, the necessity to leave hand baggage in case of an evacuation.
- With respect to the rescue, the seats of the pilots were certified with lower standards than those of the cabin, which contributed to the injury of the commander.
- As seen in the previous article about B 737 700 of Midway, the TSB also echoes the problem of landing distances and recommends that the aeronautic authorities require the crew to establish a margin of error between the distance of landing distance available (LDA of runway) and actual landing distance based on current conditions.
- Subsequent to this accident Air France included a procedure for operations on land in case of storms. This procedure underlines the risk, chiefly of rain lightnings, for the

personnel on land and provides three levels of warning that can be declared by the manager.

**Conclusions**

This accident recalls other events that have happened in the same circumstances: B 757 of Britannia in Gerona (1999), MD 82 of American Airlines in Little Rock (Arkansas, 1999), Boeing 747 400 of Qantas in Bangkok (1999), etc. Air France's department of operations was already conscious of the problem at the beginning of various serious incidents in meteorological conditions with storms and with reduced visibility:

- Airbus 340-300 in Cayenne on 25 of May 2001: Gust of wind in the middle of heavy rainfall that makes the plane short of speed (the ATHR was connected) and land before the runway threshold at 2.17 G' s. This serious incident was contributed by many pilots mistrust of the ATHR action in conditions of changing wind, and that probably the co-pilot of the accident in Toronto could have disconnected the ATHR in end.
- Airbus 340-300 in Nigeria on 28 of December 2001: In an approach with reduced visibility the plane deviates from the axis of the runway due to a change of wind. While the co-pilot was flying, the commander asks a 'Go Around' and instinctively pulls the sidestick and, along with the action of the co-pilot, causes a tailstrike.
- Airbus 330 in Gabon on 4 of March 2004: Approach and landing with storm that causes that the right undercarriage to touch down out of the runway. Air France, in its annual plan of the prevention of accidents (April 2004 to March 2005) had identified the runway excursion as an area of risk and incited to carry out go around with a training program in a flight simulator in case they would lose visual references under the MDA.
- In fact, the two pilots of the accident in Toronto received this training. The truth is that its program of prevention had taken in account what happened in Toronto and for example, in the recurrent course of the year 2003 there was a presentation on destabilized approaches in which it was briefly encouraged to go around. In the final slide it concluded: "A go-around is an option that remains open up to landing. After the selections of reverses it is too late!". To finalize, the TSB in its recommendations of safety also involved the aeronautic authorities. We will recall and take note of what is said textually in one of the recommendations of the TSB, and we will expect it to be adopted as much in Europe as in Spain: "Therefore, the Board also recommends that France's Direction Generale de l'Aviation Civile and other civil aviation authorities establish clear standards limiting approaches and landings in convective weather."