



**AERONÁUTICA CIVIL**  
UNIDAD ADMINISTRATIVA ESPECIAL

5001 - 173



Libertad y Orden

GRIAA



Grupo de Investigación de  
Accidentes e Incidentes aéreos

# PRELIMINARY REPORT

**Investigation COL-16-37-GIA**  
**Fuel Exhaustion**  
**Accident on 29, November 2015**  
**Aircraft AVRO 146-RJ85, Reg. CP2933**  
**La Unión, Antioquia – Colombia**



## WARNING

**The information presented here by the AIG Authority of Colombia (Grupo de Investigación de Accidentes Aéreos – GRIAA) is issued according the statements of Annex 13, International Civil Aviation Organization and the Colombian Aeronautical Regulations, RAC 8.**

**All investigations are conducted with the sole objective of improving aviation safety and are not intended to apportion blame or liability. The investigations are independent, separate and conducted without prejudice to any judicial or administrative action that may be taken to determine blame or liability.**

**This document is a Preliminary Report and has been prepared on the basis of the initial information gathered in the course of the investigation, without any analysis. Some of the points covered may evolve with time. Nothing in the presentation of this document or in any of the points raised therein should be interpreted as an indication of the conclusions of the investigation.**

*This is a translation into English by GRIAA of the Preliminary Report. As accurate as the translation may be, the original text in Spanish is the work of reference.*

## GLOSSARY

<b>AAIB</b>	Air Accidents Investigation Branch
<b>AGL</b>	Above Ground Level
<b>APU</b>	Auxiliar Power Unit
<b>ATC</b>	Air Traffic Controller
<b>CAS</b>	Calculated Air Speed
<b>CENIPA</b>	Centro de Investigação e Prevenção de Acidentes Aeronáuticos
<b>CVR</b>	Cockpit Voice Recorder
<b>DGAC</b>	Dirección General de Aeronáutica Civil de Bolivia
<b>FADEC</b>	Full Authority Digital Engine Control
<b>FDR</b>	Flight Data Recorder
<b>FL</b>	Flight Level
<b>GPS</b>	Global Position System
<b>GRIAA</b>	Grupo de Investigación de Accidentes Aéreos – AIG COLOMBIA
<b>kt</b>	Knots
<b>msl</b>	mean sea level
<b>NM</b>	Nautical Miles
<b>NVM</b>	Non Volatile Memory
<b>SBGR</b>	Aeroporto Internacional Guarulhos – São Paulo (Brasil)
<b>SKBO</b>	Aeroporto Internacional Eldorado – Bogotá (Colombia)
<b>SKRG</b>	Aeroporto Internacional José María Córdoba – Rionegro (Colombia)
<b>SLVR</b>	Aeroporto Internacional Viru Viru – Santa Cruz (Bolivia)
<b>SLCB</b>	Aeroporto Internacional Jorge Wilstermann – Cochabamba (Bolivia)
<b>SLCO</b>	Aeroporto Capitán Aníbal Arab - Cobija (Bolivia)
<b>UTC</b>	Universal Time Coordinated
<b>VOR</b>	Very High Frequency Omnidirectional Range

## SINOPSIS

<b>Aircraft:</b>	AVRO 146-RJ85
<b>Date and time:</b>	29 November 2016, 02:58UTC <sup>1</sup>
<b>Location:</b>	“Cerro Gordo”, Municipality of La Unión Antioquia – Colombia.
<b>Coordinates:</b>	N05°58'43.56" – W075°25'7.86"
<b>Type of operation:</b>	Commercial Air Transport (Passengers) Charter Flight
<b>Operator:</b>	LAMIA CORPORATION S.R.L
<b>Persons on board:</b>	04 Crew 73 Passengers

## 1. FACTUAL INFORMATION

### 1.1 Background to the flight

The operator had been chartered to fly the Chapecoense football team and associated personnel from São Paulo, Brazil (Guarhulos SKGR airport) to Rionegro, Colombia (Jose Maria Cordoba Airport in Rionegro, near Medellin). Under Brazilian regulations charter flights may only normally be operated by an operator based in either the country of departure or arrival. The operator was based in Bolivia and was unable to get the necessary permission to operate the flight as planned. Arrangements were made instead for the passengers to be flown from São Paulo – Brazil (ICAO: SBGR) on a scheduled flight to Santa Cruz – Bolivia (ICAO: SLVR) where they boarded the charter flight to Rionegro – Colombia (ICAO: SKRG).

### 1.2 History of flight

The history of the flight has been compiled from a number of sources, including preliminary information from the flight data recorder (FDR), cockpit voice recorder (CVR) and recorded ATC and radar data. The ATC transcript is a translation of the original transmissions which were in Spanish.

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<sup>1</sup> All times in this report are UTC. Five (5) hours should be subtracted to obtain the legal time in Colombia. Four (4) hours should be



On 28 November 2016, the aircraft departed the operator's maintenance base at Cochabamba (OACI: SLCB), Bolivia, at 17:19hrs and positioned to Viru Viru International Airport (OACI: SLVR), Santa Cruz in Bolivia, landing at 17:58hrs.

After the arrival of the aircraft at Santa Cruz it was refueled, with witness information indicating that the commander had instructed the maximum fuel load of 9,300 kg to be used.

It was reported that some of the crew had thought the aircraft would be refueling enroute at Cobiya Airport (OACI: SLCO). Cobiya Airport is located close to the border between Bolivia and Brazil and normally only operates during daylight hours. On 28 November 2016, it closed at 22:43hrs.

After the passengers had all arrived at Santa Cruz they boarded the aircraft and at 22:08hrs engine start commenced. On board were the operating crew; comprising a commander, co-pilot and two cabin crew members; and 73 passengers; including an engineer and dispatcher from the operator, and a private pilot who occupied the flight deck jump seat.

The aircraft took off at 22:18hrs and climbed to an initial cruising flight level of FL260, levelling at 22:41hrs. It then climbed again at 22:49hrs to FL280, levelling at 22:58hrs. It then started climb to its final cruising level of FL300 at 23:54hrs, levelling at 00:14hrs. The cruising speed was recorded as 220 kt CAS. The route flown is shown in Figure 1.

During the cruise, the CVR recorded various crew conversations about the fuel state of the aircraft and they could be heard carrying out fuel calculations. At 00:42:18hrs one of the pilots could be heard to say that they would divert to Bogota (ICAO: SKBO) to refuel but at 00:52:24hrs a further conversation took place, shortly after the aircraft was transferred to Colombian ATC, with the crew deciding to continue to Rionegro (ICAO: SKRG). At 01:03:01hrs the crew began their brief for the approach to Jose Maria Cordoba Airport, Rionegro.

At 01:15:03hrs the CVR ceased recording.

The aircraft commenced decent at 02:30:30hrs at which time it was about 75NM to the south of Rionegro. It levelled at FL250 at 02:36:40hrs and at 02:40hrs ATC transferred the crew to Medellin Approach at 02:40hrs who instructed them to descend to FL230 and to hold at Rio Negro VOR (VOR RNG).



**Figure 1. Aircraft flight track from FDR recording**

At 02:42:12hrs the crew was instructed to continue descent to FL210. At 02:43:09hrs the crew asked to hold at GEMLI RNAV Point (Figure 2), which was approved. It overflew GEMLI at 02:43:39hrs and entered the hold. (Figure 3 – each complete hold has a ground track of approximately 24 nm).

At this time there were three other aircraft holding at the Rio Negro VOR, at FL190, 18,000ft and 17,000ft. There was also an aircraft diverting into Rionegro with a reported fuel leak, about to commence its final approach to Runway 01 at Rionegro (SKRG).

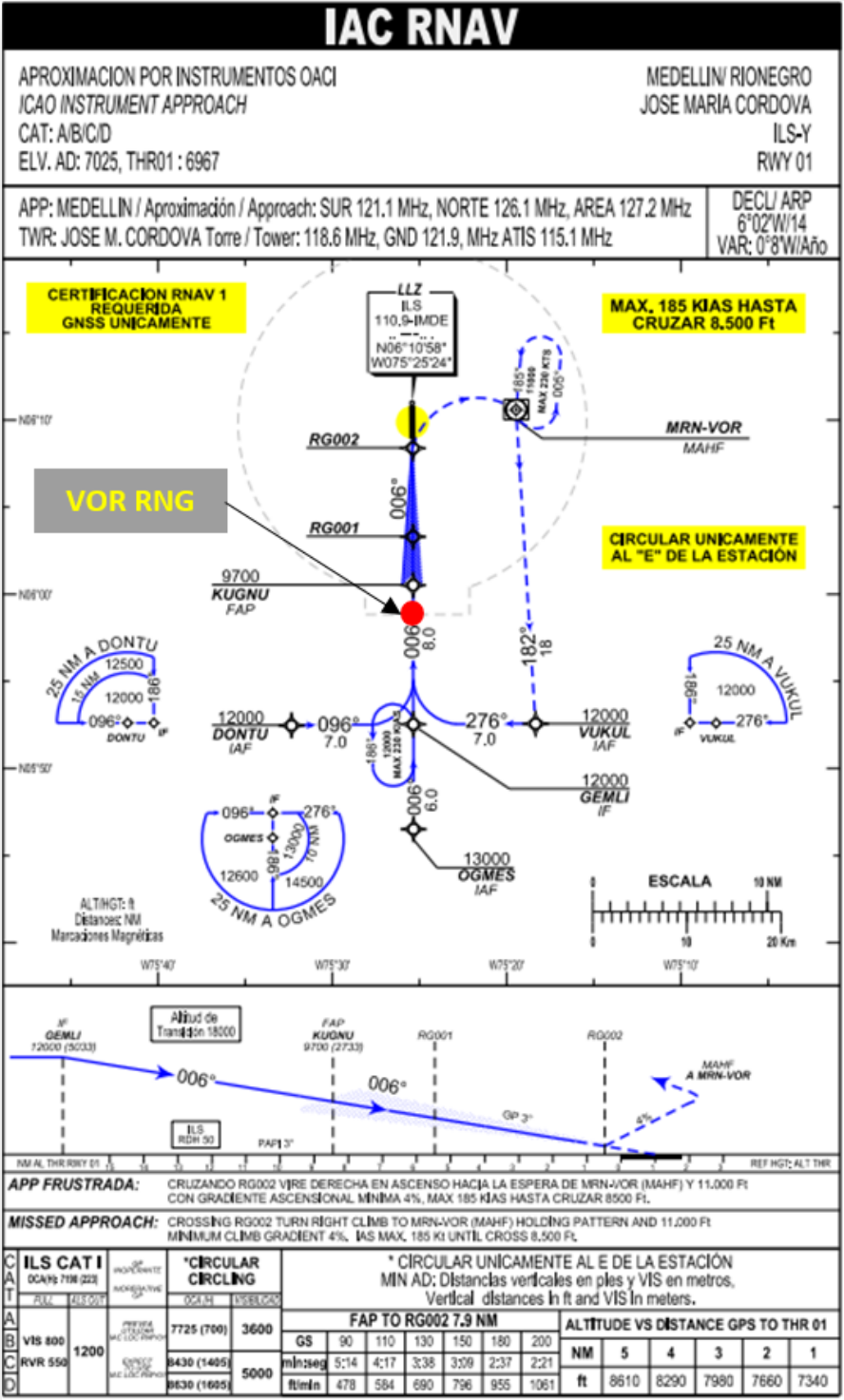
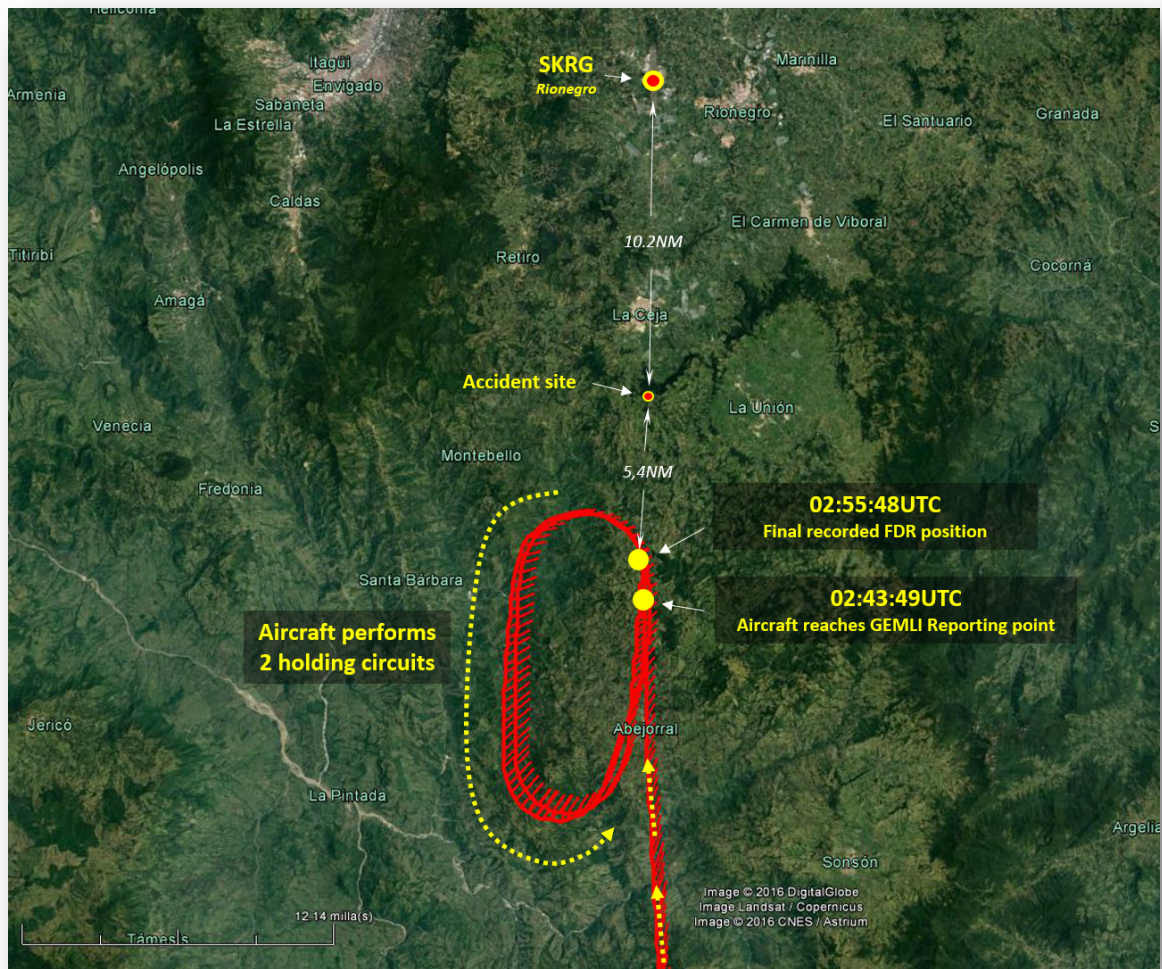


Figure 2. Approach Plate Runway 01, Rionegro





**Figure 3.** Aircraft track in the hold at GEMLI from FDR data

At 02:43:52hrs the aircraft was levelled off at FL210, the flaps lowered to FLAP18 and the speed reduced to 180 kt CAS. At 02:45:03hrs the crew informed ATC that they had entered the hold at GEMLI at FL210.

The subsequent radio communications between the crew (callsign LMI 2933) and ATC have been tabulated below.

Time (UTC)	Source of Transmission	Communication
02:47:49	LMI 2933 to ATC	'Flight level two one zero inbound'
02:49:11	LMI 2933 to ATC	'Two one zero inbound request priority for the approach, a fuel problem has occurred'
02:49:37	ATC to LMI 2933	'Understand you request priority for your landing?'
02:49:44	LMI 2933	'Affirmative'

02:49:49	ATC to LMI 2933	'Standby, I will give you vectors to proceed to the localiser and do the approach. Estimate seven minutes for approach'
02:50:00	LMI 2933 to ATC	'???? for vectors Lima Mike India two nine three three'

ATC then cleared LAN3020, the aircraft holding at 17,000ft for the approach.

02:50:57	ATC to LMI 2933	'Lima Mike India two nine three three say heading'
02:51:04	LMI 2933 to ATC	'One seven nine on outbound'
02:51:07	ATC to LMI 2933	'Keep present heading and wait to start [PAUSE] continue your descent'
02:51:12	LMI 2933 to ATC	'We will keep present heading and are waiting'
02:52:04	LMI 2933 to ATC	'Lima Mike India two nine three three request vectors for inbound Miss'
02:52:18	ATC to LMI 2933	'Standby I have an aircraft below you on the approach and in addition they are doing a runway check. How long can you remain on the approach?'
02:52:26	LMI 2933 to ATC	'With fuel emergency Miss that why I request final course'
02:52:45	LMI 2933 to ATC	'And request immediate descent, Lima Mike India two nine three three'

ATC then cancelled the approach clearance for LAN 3020

02:53:03	ATC to LMI 2933	'Lima Mike India two nine three three can you start your turn now to the right to start descent? You have traffic one mile below you.'
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At 02:53:07 hrs the thrust levers were reduced and the aircraft commenced a descent.

At 02:53:09 hrs the airbrake was extended

02:53:14	LMI 2933 to ATC	'Traffic in sight, it's not a factor and request proceed to localiser'
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At 02:53:24 hrs the gear was selected down.

02:53:20	ATC to LMI 2933	'Captain you are at two one zero, I need to lower your level would have to maintain [PAUSE] turn to your right to start your descent'
02:53:29	LMI 2933 to ATC	'Negative Miss. We're now starting descent and we are going to the localiser'

At 02:53:36 hrs FLAPS24 were selected and the aircraft speed began to reduce and continued to do so until the end of the FDR recording.

At 02:53:45hrs the Number 3 engine speed no longer matched the thrust lever demand and began to run down. 13 seconds later the same occurred on the Number 4 engine.

02:54:09	ATC to LMI 2933	'Lima Mike India 2933 you have traffic ahead of you 18,000 feet Alpha 320'
02:54:19	LMI 2933 to ATC	'Identified in TCAS and we have it above us and we are in final course'
02:54:24	ATC to LMI 2933	'The aircraft is at 18,000 Captain traffic is now leaving to the left. Additionally you have traffic that left 18,500'
02:54:35	LMI 2933 to ATC	'In sight and we are at 18,000'

At 02:54:36hrs the FDR recorded FLAPS33 selected.

At 02:54:47 hrs the Number 3 and Number 4 engine low oil pressure states were recorded on the FDR together with a MASTER WARNING. At the same time, over a 12 second period, the Number 1 engine N1<sup>2</sup> reduced from 39.5% to 29.0% and recovered.

At 02:55:04hrs the Number 2 engine speed no longer matched the thrust lever demand and began to run down.

02:55:06	ATC to LMI 2933	'Lima Mike India 2933 seventeen seven hundred, continue on the approach, runway damp, call the VOR one zero thousand if possible and if you require any ground service'
02:55:17	LMI 2933 to ATC	'We will confirm you for ground service and we are through one six thousand for the localiser'

At 02:55:19hrs, over a period of 10 seconds, the Number 1 engine N1 reduced again, from 38.1% to 29.9%, and recovered.

At 02:55:27hrs the Number 2 engine low oil pressure state and a MASTER WARNING were recorded on the FDR.

02:55:25	ATC to LMI 2933	'I remind you QNH 3027'
02:55:28	LMI 2933	'3027'

<sup>2</sup> N1 value indicates the rotation speed of the 1st (compression) stage of a turbojet engine.

At 02:55:41hrs the Number 1 engine began to run down

Following the loss of all engines, at 02:55:48hrs the FDR ceased recording. At this time the FDR data showed that the aircraft was at a CAS of 115 kt, a ground speed of 142 kt and a pressure altitude of 15,934 ft msl.

The aircraft was 15.5 nm to the south of the threshold of Rionegro Runway 01 and 5.4 nm south of the accident site (which was at an elevation of about 8,500 ft amsl).

Radar recording report indicates Mode C lost at 02:55:52hrs at which time there was only a primary radar contact for the aircraft.

02:57:10	LMI 2933 to ATC	'Miss, Lima Mike India 2933 is in total failure, total electrical failure and without fuel'
02:57:29	ATC to LMI 2933	'Runway clear and operable, rain over station, Lima Mike India 2933, fire trucks on alert'
02:57:40	LMI 2933 to ATC	'Roger, Lima Mike India. Vectors Miss, vectors to the runway.'
02:57:46	ATC to LMI 2933	'Radar signal lost, I don't have you. Say heading now.'
02:57:55	LMI 2933 to ATC	'We are with [PAUSE] with heading three six zero.'
02:58:01	ATC to LMI 2933	'With heading, turn left zero one zero, would proceed to localiser of Rionegro VOR 1 mile ahead of VOR, at this time you are at, correct, I confirm you [PAUSE] turn left heading three five zero'
02:58:18	LMI 2933	'Left heading 350 Miss'
02:58:20	ATC to LMI 2933	'Yes, correct, you are at 0.1 miles from the Rionegro VOR'
02:58:30	ATC to LMI 2933	'I don't have you [PAUSE] with the altitude Lima Mike India'
02:58:38	LMI 2933 to ATC	'9,000 feet Miss'
02:58:42	LMI 2933 to ATC	'Vectors'
02:58:48	ATC to LMI 2933	'You are at 8.2 miles from runway'
02:58:53	LMI 2933 to ATC	'Altitude'
02:58:54	ATC to LMI 2933	'What is your altitude now?'

No further response was received from LMI 2933 despite repeated calls by ATC.

### 1.2.1 Organization of Investigation

At 03:10hrs, the Grupo de Investigación de Accidentes Aéreos (GRIAA) from the Civil Aviation Authority of Colombia was alerted of the disappearance and subsequent location of the aircraft AVRO RJ85 accident in “Cerro Gordo”, Municipality of La Unión - Antioquia.

Immediately in accordance with the provisions of Colombian Aeronautical Regulations - RAC 8, a safety investigation was immediately initiated by GRIAA.

A team of 8 investigators traveled to the accident site on the morning of 29 November 2016, arriving at 11:30hrs. The access to the crash site was done by land and air.

Flight Recorders (FDR, CVR) were found on 29, November 2016 at 17:09hrs and placed in custody of GRIAA investigators for further preparation for readout.

Following the International Civil Aviation Organization (ICAO) Annex 13 provisions, the GRIAA made the formal Notification of the Accident to:

- International Civil Aviation Organization - OACI
- The Dirección General de Aeronáutica Civil – AIG (Bolivia), as State of Registration of the aircraft.
- The Air Accident Investigation Branch - AAIB (United Kingdom), as State of Manufacture of the aircraft. This allowed the assistance of technical advisors of the aircraft manufacturer.
- The National Transportation Safety Board - NTSB (United States), as State of Engine Manufacture. This allowed the assistance of technical advisors of the engine manufacturer.
- The Centro de Investigação e Prevenção de Acidentes Aeronáuticos - CENIPA (Brazil), As State of the Nationals involved in the accident.

The Investigation was organized in different working groups in the areas of Airworthiness, Power Plants, Flight Operations, Human Factors, Survival and Air Traffic. The Accredited Representatives and Technical Advisors were divided into the formed working groups.

This preliminary report contains facts which have been determined up to the time of issue. This information is published to inform the aviation industry and the public of the general circumstances of the accident and should be regarded as tentative and subject to alteration if additional evidence becomes available.



### 1.3 Injuries to persons

Injuries	Crew	Passengers	Total	Others
Fatal	3	68	71	-
Serious	-	4	4	-
Minor/None	1	1	2	-
<b>TOTAL</b>	<b>4</b>	<b>73</b>	<b>77</b>	<b>-</b>

### 1.4 Damage to the aircraft

Destroyed.

### 1.5 Other Damage

Damage to surrounding vegetation.

### 1.6 Personnel Information

#### Captain

**Age:** 36  
**Licence:** Airline Transport Pilot - ATP  
**Nationality:** Bolivian  
**Medical Certificate:** 1st. Class  
**Last proeficiency check:** 03, July 2016  
**Total flying hours:** 6,692.51 (Ref: LAMIA status documents 20 Nov 2016)  
**Total RJ85 flying hours:** 3,417.41 (Ref: LAMIA status documents 20 Nov 2016)

#### Co-pilot

**Age:** 47  
**Licence:** Airline Transport Pilot - ATP  
**Nationality:** Bolivian

**Medical Certificate:** 1st. Class

**Last proeficiency check:** 03, July 2016

**Total flying hours:** 6,923.32 (Ref: LAMIA status documents 20 Nov 2016)

**Total RJ85 flying hours:** 1,474.29 (Ref: LAMIA status documents 20 Nov 2016)

## 1.7 Aircraft Information

**Manufacturer:** BAE

**Model:** 146 AVRO RJ-85

**Serial number:** E2348

**Registration:** CP2933

**Airworthiness certificate:** NRO°405, valid

**Registration certificate:** N°834

**Total flight hours:** 21,640:45Hrs

**Total Cycles:** 19,737

## Engines

**Manufacturer:** Honeywell

**Model:** LF507-1F

The accident aircraft was powered by four Honeywell LF507-1F turbofan engines. The LF507-1F is a geared turbofan featuring a single-stage fan, a single-stage axial low pressure compressor (LPC), a 7-stage axial and single-stage centrifugal high pressure compressor (HPC), an annular combustor, a 2-stage high pressure turbine (HPT), and 2-stage low pressure turbine (LPT). The LF507-1F is rated at 7,000 pounds thrust (maximum).

General engines data are:

Position	S/N	TSN	CSN	TSI	CSI	FADEC S/N
1	P07867	19,293	17,607	129	104	3AGT172
2	P07873	18,629	17,084	1,729	6,000	9AL6735
3	P07794	18,566	17,449	134	108	not observed
4	P07812	16,876	15,622	133	107	9ALG722

## 1.8 Meteorological Information

The Meteorological Aerodrome Report (METAR) for Rionegro at 03:00hrs on 29 November 2016 reported variable light winds of 2 kt, with visibility in excess of 10 km in light drizzle. It reported broken cloud with a base of 1,500 ft above airfield level (aal) and scattered cloud with a base of 8,000 ft aal. The reported temperature was 17°C and dew point of 16°C. The QNH was 30.25 In Hg (1025 hPa).

## 1.9 Flight Recorders

The aircraft was fitted with a CVR and FDR, both of which were powered by the aircraft's AC Essential electrical bus which required one or more of the engines or the APU to be running. Both recorders were recovered to the Air Accidents Investigation Branch (AAIB) in the UK for download.

### 1.9.1 Flight data recorder

The FDR download revealed approximately 54 hours of operation which included the accident flight. A number of flight parameters were recorded including flight control positions, autopilot and autothrust modes, aircraft position, engine fan speed (N1) and thrust lever position. Fuel flow was recorded for each engine every 64 seconds. APU operation, fuel quantity, fuel and master cautions were not recorded.

### 1.9.2 Cockpit voice recorder

The CVR was successfully downloaded and recorded just over two hours of operation. Using the recorded UTC timings from radio transmissions and the FDR, the CVR was time-aligned and revealed a recording start time of 23:08:33hrs on 28 November 2016. The following two hours of recording was of the accident flight. The recording then ceased at 01:15:0hrs at which time the aircraft was about 550 nm from Rionegro and was one hour, 40 minutes and 45 seconds prior to the end of the FDR recording.

There was no recorded discussion about the CVR and the reason for the CVR recording ceasing early is unknown at this stage in the investigation.

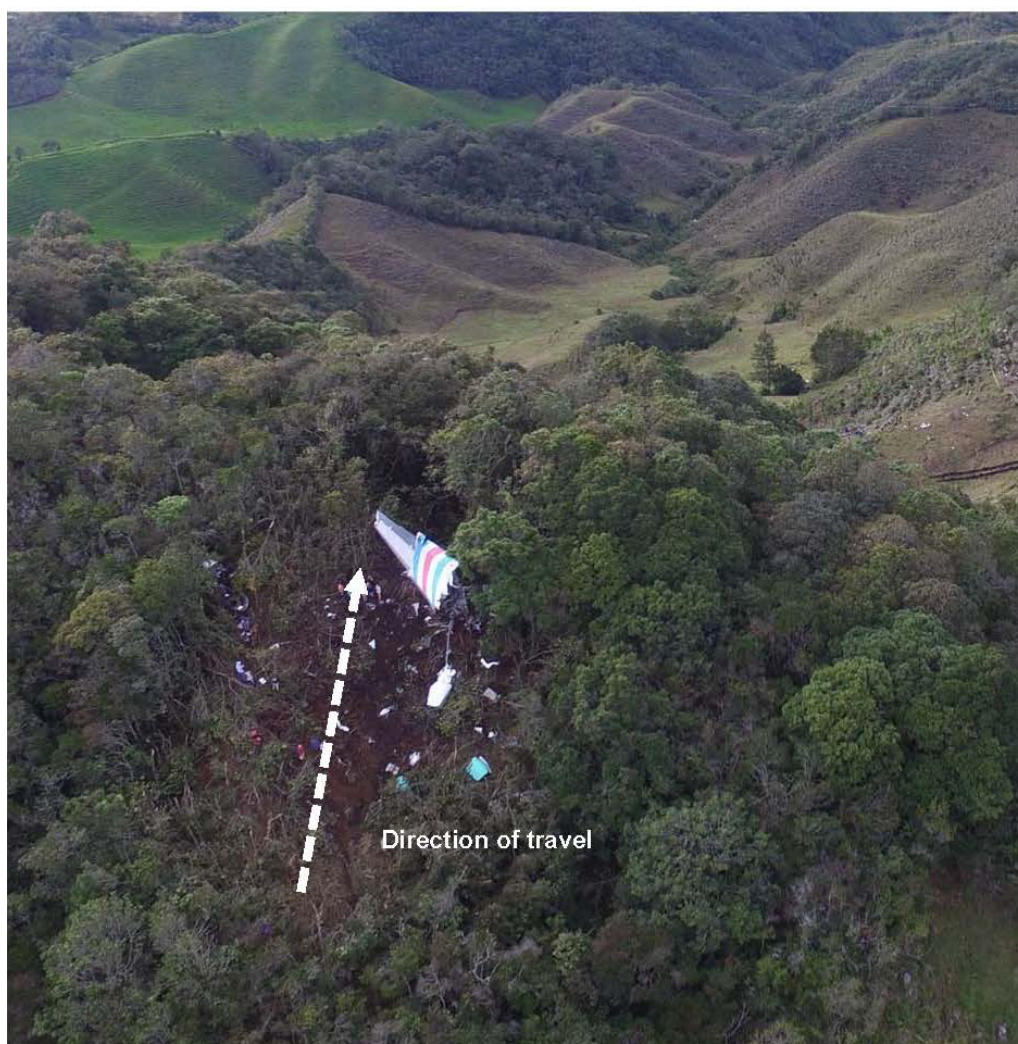
## 1.10 Wreckage and impact information

The crash site was known as "Cerro Gordo", which belonged to the Municipality of La Unión in the Department of Antioquia - Colombia. The wreckage were disturbed during search and rescue operations following the accident. Access to the crash site was limited several days and lifting equipment was not available.

### 1.10.1 Initial impact site

The initial point of impact was identified on the south face at the hill just below the hill ridge on an approximately  $310^{\circ}$  compass heading. According to the GPS readings, an energy path extended from the IPI approximately 140 meters down the north hill face to the main wreckage location, on an approximate  $290^{\circ}$  compass heading.

The approximate GPS position of the initial impact site was  $N05^{\circ}58'43.56'' - W075^{\circ}25'7.86''$ . The largest item was the tail unit, complete with rudder and both elevators (Figure 4 and 5). The tail unit had detached from the main fuselage at the pressure bulkhead frame. The leading edges of the horizontal stabilizers and fin were in good condition with little evidence of damage. The airbrakes were close to the tail unit and remained attached to it by electrical wiring.



*Figura 4. Direction of travel*





*Figure 5 Tail unit showing fin leading edge*

Components from the hydraulic bay and Environmental Control System (ECS) bay were identified at the initial impact site. These included hydraulic reservoirs and a heat exchanger from the air conditioning packs.

The stick push reservoir was identified at the site. The reservoir is installed in the upper section of the avionics bay, beneath the cockpit floor.

Other noteworthy items identified at the initial site included a main landing gear door, a section of inboard engine accessory gearbox (complete with starter motor), an engine hydro-mechanical unit, the rear section of the outboard fairing from the right wing and a passenger seat cover.

### **1.10.2 Engines**

The Number 1 and Number 4 engines were found in the proximity to the initial impact point, with Number 1 engine to the left of the impact site and Number 4 to the right. Number 2 and Number 3 engines were found in the area of the main wreckage with Number 2 engine to the left of the area and Number 3 to the right (Figure 6). The Number

3 engine was found lying in a large uprooted tree on a slope which was considered unstable and a thorough examination of the engine was not possible.



*Figure 6. Engines locations in main wreckage site*

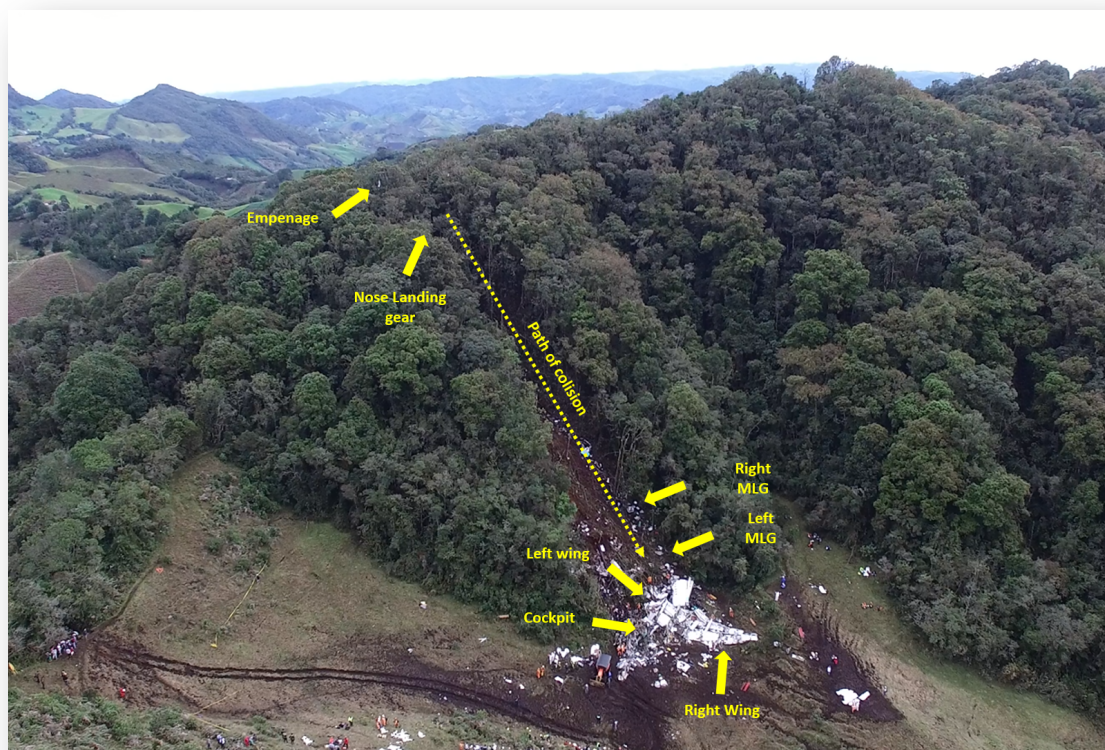
Examination of the Number 1, 2 and 4 engines revealed no evidence of fire, uncontainment, or internal engine failure. There was varying amounts of damage to the engines and each had soil and tree debris packed between the fan blades. None of these engines showed any circumferential or spiral scoring to the fan spinner. The state of the engines examined was consistent with these engines not being under power at the time of impact.



### 1.10.3 Main wreckage site

The approximate GPS position of the main wreckage site was N05°58.725, 75°25.138. The main site was approximately 140 m from the initial impact site.

Major assemblies identified included the cockpit, forward fuselage, wings, rear fuselage and the Number 2 engine. The wreckage had travelled downhill, passing through and disrupting trees (Figure 7).



*Figure 7. Location and path of the main wreckage through the trees*

The wings remained attached to the centre box (which forms the centre fuel tank) and were in the direction of travel but inverted. The orientation of the wings indicates that the centre fuselage rolled through 180° after the tail unit separated. The rear fuselage was upright but was facing opposite to the direction of travel. The majority of the rear pressure bulkhead remained attached to the rear fuselage.

The left main landing gear was identified in close proximity to the rear fuselage. The side stay was locked, indicating that the landing gear was DOWN at the time of the accident.

The cockpit was disrupted and had been disturbed during search and rescue operations. The position of switches and levers could not therefore be relied upon as being in the same position as at the time of the accident.

The centre console and throttle quadrant was identified.

The airbrake lever was slightly aft of IN.

All four throttle levers and the flap selection lever had been broken off in the accident. The remains of the throttle levers were staggered and the remaining section of the flap lever was in the 30 DEG position.

The cockpit overhead panel was identified and its orientation was indicative of the cockpit section coming to rest inverted.

Both starboard wing flap screwjacks were fully extended, indicating that the flaps were in the 33 DEG, fully extended position at the time of impact. The port wing inboard screwjack was in the fully extended position. The port wing outboard screwjack was not accessible.

The starboard aileron, complete with servo and trim tabs, remained partially attached to the wing. It was not possible to identify the position of the aileron when the accident occurred.

The left wing was very badly disrupted and it was not possible to examine the port aileron.

The rudder and both elevators were still attached to the tail unit. It was not possible to identify the position of the control surfaces when the accident occurred.

The airbrakes were found slightly open.

The nose landing gear shock absorber piston, lower torque link and both wheels were identified approximately 15 m from the initial impact point, in the direction of travel.

#### **1.10.4 Fuel**

The starboard wing fuel tank had been split open during the accident sequence. With the exception of slight fuel odour in the immediate vicinity of the fuel tanks, there was no apparent evidence of fuel anywhere on the crash site.

The refuel panel (Figure 8) had a fuel upload of 9,300 kg selected. All the three fuel contents gauges within the panel indicated below zero, commensurate with readings when electrical power is removed. The three fuel valve selection switches were in the PRE-SELECT position.





Figure 8 Refuel panel

### 1.11 Fire

There was no evidence of fire.

### 1.12 Fuel Planning Information

The operator had submitted flight information to a commercial flight planning company at 1325 on 28 November 2016 in order to create a flight plan for the flight from Santa Cruz to Rionegro.

The route used to create the plan was the same as that used on the ATC flight plan submitted prior to departure. The plan gave a ground distance for the flight of 1,611 nm and a trip fuel requirement of 8,658 kg.

The only other fuel requirement submitted to create the plan was for a taxi fuel requirement of 200 kg. This gave a total fuel requirement for the flight of 8,858 kg, but with no allowance for diversion, holding or contingency fuel requirements.

The plan was created using a cruising flight level of FL300 and an aircraft takeoff weight of 32,991 kg. The plan recorded an increased trip fuel requirement of 64 kg for every additional 1,000 kg above this weight.

Other flight plans were found in the aircraft after the accident covering different routes. These included a series of three plans created on 26 November 2016 covering separate flights from São Paulo to Santa Cruz, Santa Cruz to Cobiya and Cobiya to Rionegro. The

Cobija to Rionegro plan had used Bogota as a diversion and included a diversion fuel requirement of 837 kg and a 30minute holding fuel requirement of 800 kg.

### 1.13 Estimated Load-sheet

The actual load-sheet was not located at the accident site nor has a copy been located elsewhere. In order to estimate the take-off weight for the flight the following information was used.

Item		Weight (Kg)	Reference source
Aircraft Operating weight empty		25,844kg	Operator's Aircraft Description and Status Summary
Estimated Fuel	Fuel remaining from previous flight SLCB – SLVR 28th Nov 2016	7,437kg	Operator's Maintenance Log Book / Flt Log Book ref: LAM-MNT-15-001 / LAM-Ops-15-001 page 000122
	Fuel Uplift 2050litres @ 0.798spg	1,636kg	Fuel Uplift receipt from Santa Cruz
	Total Fuel	9,073kg	Max fuel that can be loaded is 9,362Kg ref BAES weight and balance manual
Passengers (including non-operational crew)	73 x 85kg/pax	6,205kg	80Kg/pax + 5kg/hand luggage ref LaMia Ops Manual Part A Chapter 9
Checked Baggage	Not fully known	488kg	Weighed luggage recovered from accident site
Minimum estimated Take-off Weight		41,610kg	

It is considered likely that the actual weight of baggage onboard the aircraft at the time of the accident was higher than the weight of the baggage recovered from the accident site. Baggage weight information obtained from the flight transferring passengers from São Paulo to Santa Cruz indicates that the baggage weight of those passengers transferring onto the accident flight was 1,026 kg. This would suggest a minimum estimated takeoff weight of 42,148 kg.

The maximum allowed takeoff weight for the aircraft, recorded in the aircraft Flight Manual is 41,800 kg.

### 1.14 ATC flight plan

The dispatcher accompanying the flight submitted a flight plan on 28 November 2016 at about 20:10hrs at the flight plan office at Santa Cruz Airport. The submitted flight plan

gave a departure time of 22:00hrs and a cruising flight level of FL280. The flight time and endurance were both recorded on the plan as 4 hrs 22 minutes.

The flight plan office requested that the flight plan was changed and re-submitted due to the following issues with the plan:

- The route did not include a standard instrument departure (SID) from Santa Cruz
- There was no second alternate airport included in the plan
- The estimated enroute time (EET) was the same as the endurance
- The dispatcher had only signed the plan but had not printed his name

The dispatcher apparently had refused to change any of the details and explained that, regarding the EET and endurance being the same, the actual flight time would be less than that on the plan. The flight plan office filed the flight plan at about 20:30hrs but sent a report to the DGAC regional office giving details of the incident, stating that under the regulations the office was not empowered to reject the submission.

## 2. Further actions

A team of investigators carried out a visit to the DGAC facilities in Bolivia in order to gathering information about the Operator and Regulations. The DGAC of Bolivia and the Prosecutors in La Paz, Cochabamba and Santa Cruz contributed and provided all the support to verify the Operators documents; however, the AASANA institution, did not provide any information, related to the air navigation services and interviews.

The action taken by DGAC (Bolivia), as result of the information regarding the accident, the operator's Air Operator Certificate (AOC) had been suspended.

The evidence available to the investigation at the time of issue of this preliminary report has not identified a technical failure that may have caused or contributed to the accident. The available evidence is however consistent with the aircraft having suffered fuel exhaustion.

The investigation into the accident continues and will concentrate on issues related to fuel planning, decision making, operational oversight, survival and organizational oversight.

GRIAA will publish a final report once the full investigation is completed.

Information updated on 22, December 2016, 20:26hrs.

## GRUPO DE INVESTIGACIÓN DE ACCIDENTES - GRIAA

Unidad Administrativa Especial de Aeronáutica Civil de Colombia



**Grupo de Investigación de Accidentes & Incidentes**  
**Av. Eldorado No. 103 – 23, OFC 203**  
**[investigación.accide@aerocivil.gov.co](mailto:investigación.accide@aerocivil.gov.co)**  
**Tel. +57 1 2962035**  
**Bogotá D.C - Colombia**