COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
A-106/CENIPA/2020

OCCURRENCE:	**ACCIDENT**
AIRCRAFT:	**PR-AUR**
MODEL:	**Gulfstream 200**
DATE:	**07SET2020**

NOTICE

According to the Law nº 7565, dated 19 December 1986, the Aeronautical Accident Investigation and Prevention System – SIPAER – is responsible for the planning, guidance, coordination, and execution of the activities of investigation and prevention of aeronautical accidents.

The elaboration of this Final Report was conducted considering the contributing factors and hypotheses raised. The report is, therefore, a technical document which reflects the result obtained by SIPAER regarding the circumstances that contributed or may have contributed to triggering this occurrence.

The document does not focus on quantifying the degree of contribution of the distinct factors, including the individual, psychosocial or organizational variables that conditioned the human performance and interacted to create a scenario favorable to the accident.

The exclusive objective of this work is to recommend the study and the adoption of provisions of preventative nature, and the decision as to whether they should be applied belongs to the President, Director, Chief or the one corresponding to the highest level in the hierarchy of the organization to which they are being forwarded.

This Final Report has been made available to the ANAC and the DECEA so that the technical-scientific analyses of this investigation can be used as a source of data and information, aiming at identifying hazards and assessing risks, as set forth in the Brazilian Program for Civil Aviation Operational Safety (PSO-BR).

This Report does not resort to any proof production procedure for the determination of civil or criminal liability, and is in accordance with Appendix 2, Annex 13 to the 1944 Chicago Convention, which was incorporated in the Brazilian legal system by virtue of the Decree nº 21713, dated 27 August 1946.

Thus, it is worth highlighting the importance of protecting the persons who provide information regarding an aeronautical accident. The utilization of this report for punitive purposes maculates the principle of "non-self-incrimination" derived from the "right to remain silent" sheltered by the Federal Constitution.

Consequently, the use of this report for any purpose other than that of preventing future accidents, may induce to erroneous interpretations and conclusions.

N.B.: This English version of the report has been written and published by the CENIPA with the intention of making it easier to be read by English speaking people. Considering the nuances of a foreign language, no matter how accurate this translation may be, readers are advised that the original Portuguese version is the work of reference.

SYNOPSIS

This is the Final Report of the 07th September 2020 accident involving the Gulfstream 200 aircraft, registration marks PR-AUR. The occurrence was typified as “[RE] Runway Excursion”.

During a touch-and-go landing exercise, after touchdown on the runway 13, the crew of the PR-AUR aircraft aborted the subsequent takeoff run, when there was not enough runway length remaining to stop the aircraft within the runway limits. The aircraft ended up overrunning the departure end of the runway, colliding with a nearby protective fence.

The aircraft sustained substantial damage.

The Pilot in Command (PIC) suffered minor injuries. The pilot Second in Command (SIC) and the extra crew member received no injuries.

An Accredited Representative of the Civil Aviation Authority - Ministry of Transport (CAA-MT) from Israel, the State of manufacture of the aircraft, was designated for participation in the investigation.

TABLE OF CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ADC	Aerodrome Chart
AFM	Aircraft Flight Manual
AISWEB	Aeronautical Information Service on the WEB
ANAC	Brazil's National Civil Aviation Agency
APP	Approach Control
APP-BH	*Belo Horizonte* Approach Control
CAA-MT	Civil Aviation Authority - Ministry of Transport
CAVOK	Ceiling And Visibility Ok – no clouds below 5000 ft. or below the height of the highest sector (whichever the highest) and horizontal visibility more than 10 km; no CBs or significant weather condition for aviation
CENIPA	Brazil's Aeronautical Accidents Investigation and Prevention Center
CMA	Aeronautical Medical Certificate
CVA	Certificate of Airworthiness-Verification
CVR	Cockpit Voice Recorder
EGPWS	Enhanced Ground Proximity Warning System
EICAS	Engine Indicating and Crew Alerting System
FDR	Flight Data Recorder
FMS	Flight Management System
IAF	Initial Approach Fix
IAM	Annual Maintenance Inspection
IFR	Instrument Flight Rules
IFRA	IFR Flight Rating – Airplane
LFL	Landing Field Length
METAR	Routine Meteorological Aerodrome Report
OM	Maintenance Organization
PAPI	Precision Approach Path Indicator
PCM	Commercial Pilot License - Airplane
PF	Pilot Flying
PIC	Pilot in Command
PLA	Airline Transport Pilot – Airplane
PM	Pilot Monitoring
PN	Part Number
POB	Persons On Board
PPR	Private Pilot License - Airplane
RBAC	Brazilian Civil Aviation Regulation
SBBH	ICAO location designator - *Pampulha* (*Carlos Drummond de Andrade*) Aerodrome, *Belo Horizonte*, State of *Minas Gerais*

SIC	Pilot Second in Command
SID	Standard Instrument Departure
SIPAER	Aeronautical Accidents Investigation and Prevention System
SN	Serial Number
TPP	Private Air Services Aircraft Registration Category
T/R	Thrust Reverser System
TWR-BH	*Pampulha* Aerodrome Control Tower (Belo Horizonte)
UTC	Coordinated Universal Time
V_{APP}	Minimum Landing Approach Speed
VFR	Visual Flight Rules
V_{REF}	Minimum Final Approach Speed

1. FACTUAL INFORMATION.

Aircraft	**Model:** Gulfstream 200 **Registration:** PR-AUR **Manufacturer:** Israel Aircraft Industry	**Operator:** *W.R.V. Empreendimentos e Participações Ltda*.
Occurrence	**Date/time**: 07SET2020 - 21:45 (UTC) **Location:** *Pampulha* Aerodrome (SBBH) **Lat.** 19°51'07"S **Long.** 043°57'02"W **Municipality – State:** *Belo Horizonte – Minas Gerais*.	**Type(s):** [RE] Runway excursion

1.1. History of the flight.

At approximately 21:35 UTC, the aircraft took off from SBBH (*Pampulha - Carlos Drummond de Andrade* - Aerodrome, *Belo Horizonte*, State of *Minas Gerais*) on a local instrument training flight with touch and goes, with 03 POB (two pilots and an extra crew member).

The flight proceeded uneventfully until the first approach. During the run after touching down, the aircraft overran the departure end of the runway in a direction slightly to the right of the longitudinal axis, and collided with a nearby protective fence located past the departure end of runway 13. The airplane came to a stop at a distance of 95 m from the runway limits.

The aircraft sustained substantial damage.

The PIC suffered minor injuries. The SIC and the extra crew member were not injured.

Figure 1 – Situation of the PR-AUR aircraft after coming to a stop.

1.2. Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	1	-	-
None	2	-	-

1.3. Damage to the aircraft.

The aircraft sustained substantial damage to the entire length of its underside. The landing gear struts collapsed after impacting the terrain off the runway.

1.4. Other damage.

There was substantial damage to the protective fences located near the departure end of the runway 13.

1.5. Personnel information.

1.5.1. Crew's flight experience.

Flight Experience		
	PIC	SIC
Total	7.000:00	225:30
Total in the last 30 days	02:13	02:13
Total in the last 24 hours	02:13	02:13
In this type of aircraft	200:00	67:05
In this type in the last 30 days	02:13	02:13
In this type in the last 24 hours	02:13	02:13

RMK: data on the hours flown provided by the pilots.

1.5.2. Personnel training.

The PIC did the PPR course (Private Pilot – Airplane) in 1986, at the *Aeroclube de Minas Gerais*.

The SIC did the PPR course in 2016, at the *Aeroclube de Pará de Minas*, State of *Minas Gerais*.

1.5.3. Category of licenses and validity of certificates.

The PIC held a PLA License (Airline Transport Pilot - Airplane) and had valid ratings for G200 aircraft (which included the Gulfstream 200 model) and IFRA (IFR Flights – Airplane).

The SIC held a PCM License (Commercial Pilot - Airplane) and had valid ratings for G200 aircraft and IFRA.

1.5.4. Qualification and flight experience.

The PIC and SIC, together, did the initial training to obtain type ratings on the Gulfstream 200 aircraft at Flight Safety International, Dallas Training Center, USA, in 2019.

The pilots were qualified, but it was the first time they were performing touch-and-go training on that type of aircraft.

1.5.5. Validity of medical certificate.

The pilots held valid CMAs (Aeronautical Medical Certificates).

1.6. Aircraft information.

The SN140 aircraft, was a product manufactured by Israel Aircraft Industry in 2006, and registered in the Private Air Service Registration (TPP) Category.

The aircraft had a valid CVA (Airworthiness-Verification Certificate).

The records of the technical logbooks were up to date.

The aircraft's latest inspection (type "Annual Maintenance Inspection - IAM)" was carried out on 14 November 2019 by the *Líder Táxi Aéreo* maintenance organization, in *São Paulo*, State of *São Paulo*. The aircraft flew 46 hours and 55 minutes after the said inspection.

The aircraft's latest overhaul (“type 12C - 144 months”) was conducted on 19 November 2018 by Duncan Aviation maintenance organization, in Battle Creek, Miami, USA. The aircraft flew 98 hours and 13 minutes after the referred overhaul.

The aircraft had conventional three-axis flight controls. The elevators and ailerons were hydraulically actuated. The rudder controls had an assistance system in case of asymmetrical traction.

The elevators were operated by a pair of servo-actuators and had a system of compensation for aerodynamic forces in the longitudinal axis (pitch) by means of variable incidence on the horizontal stabilizer.

The normal operation of this system was performed by means of switches located on each of the control wheels *(Pilot Flying* - PF and *Pilot Monitoring* - PM). When one of the switches was activated, the primary actuator motor was energized and moved it to the desired position.

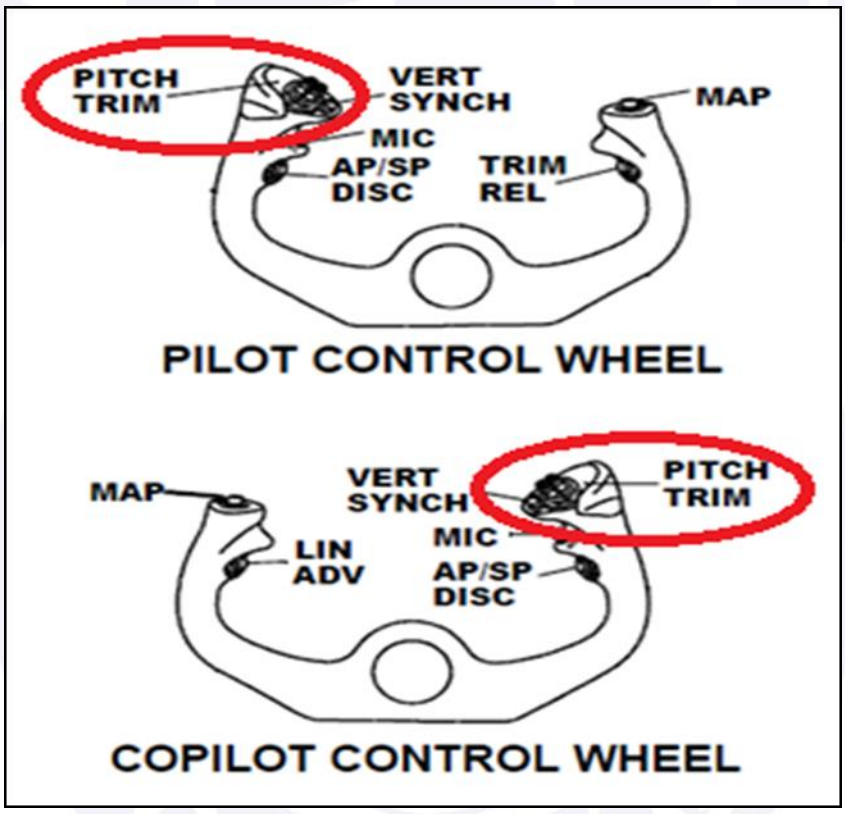


Figure 2 - Horizontal stabilizer trim controls (PF and PM).

These switches had three positions: a fixed position (*CENTER*) and two momentary positions (*NOSE DOWN* and *NOSE UP*). Whenever the normal elevator trim system was used, an audible alert came from the Engine Indicating and Crew Alerting System (EICAS).

After the start-up of the engines, the EICAS provided information about the position of the horizontal stabilizer trim tab. The variation of the horizontal stabilizer ranged from +2.5° to -9.5°, which included all the flight envelope requirements and aircraft weight and balance limits.

Figure 3 below, extracted from the Aircraft Flight Manual (AFM), represents the primary EICAS page, which contained information on the position of the flight trim tabs, highlighting the horizontal stabilizer trim tab.

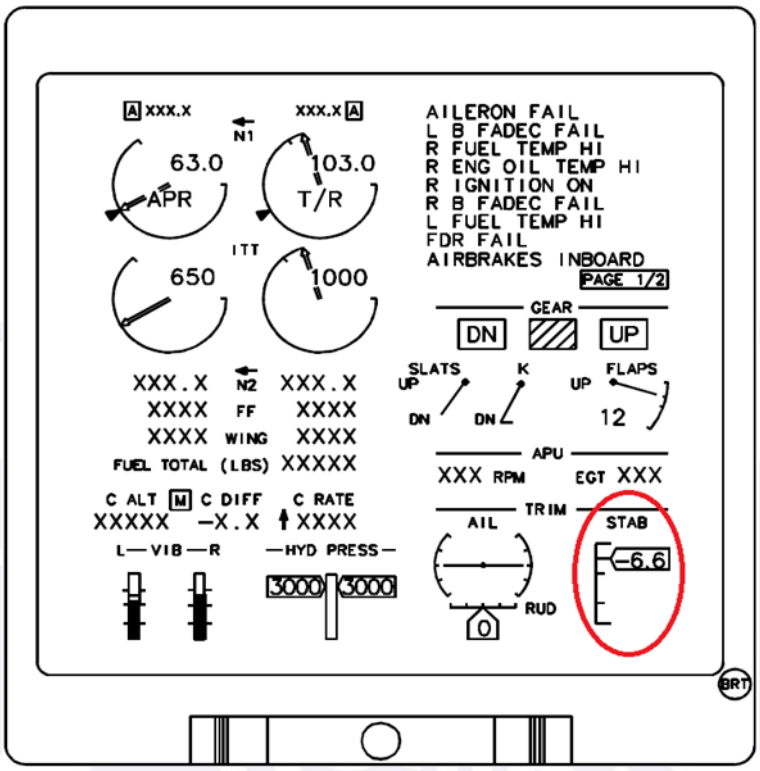


Figure 3 - Example of the horizontal stabilizer trim tab position on the primary EICAS page. Source: adapted from the Gulfstream 200 AFM.

The PR-AUR aircraft was also equipped with a *Thrust Reverser System* (T/R) intended to provide additional aerodynamic braking by redirecting the flow of the engine exhaust gases and turbine air forward, as a way to aid in stopping the aircraft.

The T/R had an actuation range that varied from the *T/R IDLE* position to the *T/R MAX* position. Figure 4, below, shows the power lever console of the PR-AUR aircraft.

Figure 4 - T/R actuation range of the PR-AUR aircraft.

In the records analyzed, the Investigation Committee did not identify any signs of anomalies or failures in the functioning of the systems capable of compromising its control and/or operation.

The aircraft was also equipped with an *Enhanced Ground Warning Alerting System* (EGPWS), which incorporated the functions of the basic *Ground Proximity Warning System*

(GPWS) with additional features, including terrain clearance, terrain proximity alert, and terrain proximity awareness display.

1.7. Meteorological information.

The routine Meteorological Airdrome Report (METAR) of SBBH (*Pampulha* Aerodrome), the site of the accident, contained the following information:

METAR SBBH 072136Z 06006KT CAVOK 25/06 Q1016.

The mishap occurred on a cloudless clear night, with a continuous wind direction of 060° at 6 kt., visibility more than 10 km, and temperature of 25°C.

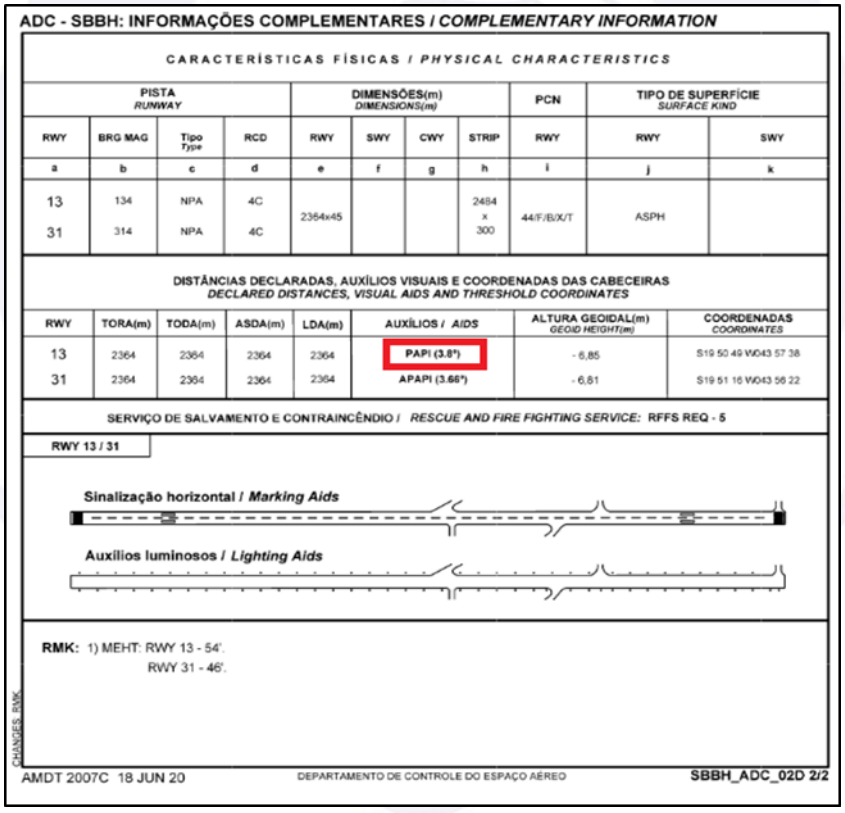
The meteorological conditions were considered favorable for VFR flights and were available to the crew before the accident flight and, according to reports from those involved, the weather data were consulted in advance.

1.8. Aids to navigation.

All navigation and landing aids were operating normally at the time of the aircraft's approach.

One of the instrument approach aids available at SBBH Aerodrome was the LOC/DME for runway 13, operating on the frequency 109.3 MHz. Despite providing indication of the approach course for threshold 13, it would not provide slope indication.

According to additional information contained in the Aerodrome Chart (ADC), the runway 13 of SBBH had a 3.8º-slope visual aid (PAPI), which was operating normally on the day of the occurrence.



ADC - SBBH: INFORMAÇÕES COMPLEMENTARES / *COMPLEMENTARY INFORMATION*

CARACTERÍSTICAS FÍSICAS / *PHYSICAL CHARACTERISTICS*

PISTA *RUNWAY*				DIMENSÕES(m) *DIMENSIONS(m)*				PCN	TIPO DE SUPERFÍCIE *SURFACE KIND*	
RWY	BRG MAG	Tipo *Type*	RCD	RWY	SWY	CWY	STRIP	RWY	RWY	SWY
a	b	c	d	e	f	g	h	i	j	k
13	134	NPA	4C	2364x45			2484 x 300	44/F/B/X/T	ASPH	
31	314	NPA	4C							

DISTÂNCIAS DECLARADAS, AUXÍLIOS VISUAIS E COORDENADAS DAS CABECEIRAS
DECLARED DISTANCES, VISUAL AIDS AND THRESHOLD COORDINATES

RWY	TORA(m)	TODA(m)	ASDA(m)	LDA(m)	AUXÍLIOS / *AIDS*	ALTURA GEOIDAL(m) *GEOID HEIGHT(m)*	COORDENADAS *COORDINATES*
13	2364	2364	2364	2364	PAPI (3.8°)	- 6,85	S19 50 49 W043 57 38
31	2364	2364	2364	2364	APAPI (3.66°)	- 6,81	S19 51 16 W043 56 22

SERVIÇO DE SALVAMENTO E CONTRAINCÊNDIO / *RESCUE AND FIRE FIGHTING SERVICE:* RFFS REQ - 5

RWY 13 / 31

Sinalização horizontal / *Marking Aids*

Auxílios luminosos / *Lighting Aids*

RMK: 1) MEHT: RWY 13 - 54'.
RWY 31 - 46'.

CHANGES: RMK

AMDT 2007C 18 JUN 20 DEPARTAMENTO DE CONTROLE DO ESPAÇO AÉREO SBBH_ADC_02D 2/2

Figure 5 - SBBH Aerodrome Chart. Source: adapted from the AISWEB.

1.9. Communications.

According to the recordings of radio communications between the crew of the PR-AUR aircraft and the control agencies, one found that there were no technical abnormalities in the communication equipment during the flight.

1.10. Aerodrome information.

It was a public/military aerodrome under the administration of INFRAERO. It operated under Visual Flight Rules (VFR) and Instrument Flight Rules (IFR), during day- and night-time.

The aerodrome had an asphalt-paved runway, with thresholds 13/31, dimensions of 2,364m x 45 m, at an elevation of 2,589 ft.

1.11. Flight recorders.

The aircraft was equipped with a Honeywell Flight Data Recorder (FDR), Part Number 980-4710-003, Serial Number 00779. In addition, it featured a Universal Avionics Cockpit Voice Recorder (CVR), PN 1603-02-12, SN 1582.

Both the flight data recorder and the cockpit voice recorder contained the data related to the occurrence.

The main information collected from the data extracted from the flight recorders and the sequence of events are transcribed in the item 1.18. “Operational Information” of this final report.

1.12. Wreckage and impact information.

The aircraft overran the departure end of SBBH runway 13 and traveled approximately 68 m before hitting a gutter.

After that, the aircraft collided with a protective fence and stopped approximately 155 m off the runway limits, slightly to the right of the extension of the runway central axis (Figures 6 and 7).

Figure 6 - Detail of the fence against which the aircraft collided after departing the runway.

Figure 7 - Trajectory traveled by the aircraft after departing the runway.

The flaps were in an extended position of 20°. The elevator trim tabs were symmetrical and positioned at the maximum stopper in the pitch-up direction.

1.13. Medical and pathological information.

1.13.1. Medical aspects.

There was no evidence that physiological or incapacitation issues could have affected the crew's performance.

1.13.2. Ergonomic information.

NIL.

1.13.3. Psychological aspects.

As learned by the Investigation Committee, the PIC had been working as a professional pilot since he earned his PCM license. He was hired by the aircraft operating company in 1997, and had flown approximately 60 hours with the SIC until the date of the occurrence.

In the period prior to the acquisition of the PR-AUR, the PIC operated another type of aircraft for that company. In addition, he was responsible for managing operational issues, performing control of maintenance for the company, and advising the owners on decision-making issues, including the ones related to the hiring of new pilots.

The SIC was hired as a co-pilot in the second half of 2019, upon recommendation from the PIC who, in addition to the professional relationship, was the SIC's father. That was the SIC's first experience as a jet pilot.

According to information collected from interviews, despite the father-son relationship between the PIC and the SIC, their posture on board the aircraft was quite professional. No elements were identified that could support the thesis that this interfered with the pilots' performance during the occurrence.

According to the pilots, since there was not a formalized touch-and-go procedure provided for in the AFM, it was necessary to improvise the actions that would be adopted while performing it.

Furthermore, according to information gathered at the interviews, at a certain point during the landing run of the first touch-and-go, the PIC realized that, due to the configuration of the aircraft, it would not be possible to perform the subsequent departure, and chose to take over the controls and reject takeoff.

However, in the recordings, it was not possible to clearly define either the exact moment of the PIC's decision to abort departure, or which of the pilots was actually operating the controls of the aircraft. One observed that there was no clear communication between the pilots after the aircraft touched down on the runway.

1.14. Fire.

There was no fire.

1.15. Survival aspects.

The pilots and the extra crew member abandoned the aircraft on their own, and received assistance from the aerodrome's firefighting team.

According to reports, the firefighters were summoned at the time of the accident, having been informed about an occurrence involving an aircraft landing on runway 13.

After receiving such information, the firefighters proceeded to the threshold of runway 13, but the aircraft had suffered a runway excursion by overrunning the departure end of the referred runway. Upon identifying the mistake, the firefighters proceeded to the correct location.

1.16. Tests and research.

NIL.

1.17. Organizational and management information.

The aircraft was operated by a private company, and was primarily intended for private transport. The fixed crew consisted of the two pilots involved in the occurrence, who were employed as captain and co-pilot, respectively.

The Investigation Committee found that there was not a formal selection process for the hiring of pilots.

Flights were scheduled in advance, subject to the company owner's demands, and the planning was done by the captain. According to reports, there was enough time for preparation of the scheduled flights.

The aircraft usually stayed overnight in a hangar of the *Pampulha* Aerodrome in *Belo Horizonte*.

1.18. Operational information.

The purpose of the flight was to perform the training of IFR procedures with touch-and-go landings, in order to compose the process of type rating revalidation of the pilots involved in the accident.

According to reports, the PIC and the SIC had never performed that type of training on the aircraft in question.

According to interviews, the touch-and-go training using the aircraft was carried out on account of the provisions of the ANAC's Ordinance nº 1,539/SPO, issued on 13 June 2020, which recognized, on an exceptional and temporary basis, alternative procedures to training in Civil Aviation Training Centers installed in locations with restricted access by Brazilians,

for conducting training and exams provided for in the Brazilian Civil Aviation Regulation nº 61 (RBAC-61) for revalidation of the type ratings, due to the impacts caused by the state of calamity in the wake of the COVID-19 pandemic.

In the case of this accident, due to the COVID-19 pandemic, there was restriction on the access of Brazilian pilots to the United States, where there was a G200 simulator. In Brazil, there was not such a simulator.

At the time of the accident, in addition to the pilots operating the aircraft, there was a third pilot, who was sitting in the jump seat. He was rated and licensed for this type of aircraft, and was supposed to deliver the same training to the PIC. The whole crew had agreed that, initially, the SIC would be trained as a PF and, later, he would swap places with the pilot in the jump seat for the training of the PIC.

It should be noted, however, that the PIC was responsible for the operation and safety of the flight, in accordance with section 91.3 (a) of the RBAC-91, Amendment 03, in force at the time.

The Investigation Committee found that the simulator training program included the following maneuvers with respect to landing:

- *Normal Landing;*
- *Landing from a Precision Approach;*
- *Crosswind Land;*
- *Approach and Landing with a Power Plant Failure;*
- *Landing from a Circling approach;*
- *Landing from a No-Flap or Nonstandard Flap Approach;*
- *Rejected Landing; and*
- *Windshear.*

These maneuvers were practiced by both pilots and were evaluated as proficient during the initial simulator training for obtainment of the type rating in 2019.

On the occasion of rating obtainment, it was observed that, in one of the initial flight simulator training sessions, the PIC was advised to improve his knowledge of aircraft procedures. The same recommendation was made to the SIC, with the addition that he should improve his basic piloting skills.

It is worth noting that, on the date of the accident, the SIC had approximately 225 total hours, 67 hours of which in the aircraft type.

The aircraft was within the weight and balance limits specified by the manufacturer, according to data collected and analyzed by the Investigation Committee.

Before takeoff, the following speeds were entered into the Flight Management System (FMS):

- V1 = 112 kt.;
- VR = 118 kt.; and
- V2 = 131 kt.

These same speeds were also adopted for the touch-and-go exercise, since the crew considered that there would be little change in the parameters between takeoff and landing.

The *Take-Off Distance* table for takeoff with flaps at 20º, with a weight 27,000 lb., dry runway, at an aerodrome altitude of 2,589 ft. and 25°C of temperature, estimated a required

distance of approximately 4,862 ft. (1,481 m), according to the Gulfstream 200 AFM information analyzed.

The flight's estimated time of departure from SBBH was 20:20 UTC. It would be conducted in accordance with instrument flight rules, with a direct route to *ERVIM* position. From *ERVIM* position, the aircraft would return to SBBH for the touch-and-go landings.

According to interviews, all preparatory procedures for the flight were performed, including consultation of the available meteorological information, as well as of other pertinent official aeronautical information.

Furthermore, the pilots stated that, before boarding the aircraft for the flight, they had received a briefing on the sequence of maneuvers to be performed.

As reported by the pilots, the flight proceeded uneventfully, and they did not notice any abnormalities. Communications with the control units were carried out as expected, the weather conditions were favorable, and both pilots felt safe to carry out the operation until the moment of the approach for the touch and go landings.

According to the information collected and the data extracted from the flight recorders, the sequence of events was the following (time referred in UTC):

- at 21:08:04, the crew released the brakes and began the takeoff run;
- at 21:10:08, already in contact with Belo Horizonte Approach Control (APP-BH), the crew received authorization to climb and maintain 8,000 ft. on the Standard Instrument Departure (SID) GEPNA 1A profile. Then, APP-BH authorized flight direct to the ERVIM position, which was the Initial Approach Fix (IAF) of the LOC RWY 13 procedure of SBBH;
- at 21:12:53, after having performed the required before-descent procedures, the PM requested authorization from APP-BH to descend, and was initially authorized to 7,000 ft. The descent was initiated while the PM completed the prescribed before-landing checks. The PM informed the PF that the Reference Airspeed (VREF) to be used would be 138 kt. and the flaps were to remain at the 20°-position. The PF confirmed being aware of the parameters to be maintained and requested that the PM place the bug (marker) at the speed of 148 kt (VREF + 10 kt);
- at 21:14:58, APP-BH authorized the descent to 5,700 ft. and requested that the crew report when the aircraft was stabilized in the IFR procedure. After that, the checklist was worked and the aircraft was prepared for the approach, with the PM noting that they could end up "high and fast";
- at 21:19:29, the PM informed APP-BH that the aircraft was stabilized on the final approach with the runway in sight. The PM then warned the PF to "*put the aircraft to descend*" or risk "*not landing*". As a result, the PF began to employ a higher rate of descent, reaching 2,200 ft. /min (the expected rate of descent on the final approach of the procedure was approximately 750 ft. /min);
- at 21:20:04, already in two-way contact with *Pampulha* Aerodrome Control Tower (TWR-BH), the PR-AUR crew received authorization to perform the touch-and-go landing;
- at 21:20:34, the EGPWS automatically issued an alert of "1,000 ft. altitude" over the terrain. At that time, the aircraft landing gear was down, flaps at 20°, indicated speed of 181 kt., the descent rate was 1,500 ft. /min, and the thrust levers were fully reduced. According to the information contained in the LOC RWY 13 procedure, at 1,000 ft. altitude, the aircraft should be at a distance of 2.5 NM from the runway 13 threshold, at a descent rate of 750 ft./ min;

- at 21:21:30, the landing gear sensors indicated that the aircraft was on the ground, and the horizontal stabilizer trim control actuation alert was activated in the *NOSE DOWN* direction, going from the -2.2°-position to the +0.8°-position;
- at 21:21:34, the engine power levers were pushed fully forward for the departure. After a brief communication between the pilots about the application of the aircraft controls and control of the aircraft on the ground, the extra crew member, who was in the jump seat, alerted the crew regarding the position of the horizontal stabilizer trim. At that moment, there was a reversal in the direction of the actuation of the referred trim;
- at 21:21:40, with an indicated speed of 147 kt., the power levers were fully reduced and the brakes were partially applied, without any clear communication between the pilots about the decision to abort the takeoff. In the subsequent moments, it was possible to observe little effectiveness of the actions on the controls aimed at stopping the aircraft; and
- at 21:21:53, the aircraft was in the final 1/3 of the runway, with an indicated speed of 114 kt., when the thrust levers were placed in the *MAX T/R* position, and the brakes began to be applied with greater amplitude. Approximately 10 seconds later, the aircraft overran the departure end of the runway at a speed of 65 kt, lost control, collided with a protective fence and stopped at a distance of 155 m from the departure end of the runway 13 of SBBH.

No formal briefing regarding landing procedures was identified in the recordings. At the interviews, the pilots stated that they had previously agreed on the procedures to be adopted. One observed just instructions given by the PIC, relative the profile to be followed during the traffic for landing, even on the final approach.

According to the flight data, when the PR-AUR passed over the threshold for landing, the aircraft had an indicated speed of 140 kt., a descent rate of 550 ft. /min, with the engine power levers fully reduced.

The aircraft touched down on the runway close to the mark of 1,000 ft. at a speed of 134 kt.

Section IV of the AFM, dealing with normal procedures, did not specifically contemplate touch-and-go landings. According to reports from the pilots, the actions to be performed during the maneuver had been previously defined in the flight planning phase.

The go-around procedure (GO AROUND) contained in the AFM (Figure 8) detailed the procedures to be performed.

GO AROUND (TWO-ENGINE)

1. Thrust levers - T/O THRUST
2. Approach Climb Speed - MAINTAIN; Press GA button and maintain a 9° deck angle minimum
3. SLATS/FLAPS lever - 20°
4. Landing gear lever - UP, after establishing positive climb gradient
5. At safe altitude (400 ft minimum) - Accelerate to flaps retraction speed (Figure 7-235)
6. FLAPS - UP, at 400 ft minimum; accelerate to climb speed.
7. GROUND A/B switch - OFF
8. T/R ARM pushbutton - PRESS (lights - out)
9. Slats - AS REQUIRED

Figure 8 - Procedures prescribed for performing a go-around with the Gulfstream 200 aircraft.

A consultation with the manufacturer regarding the *Touch-And-Go* procedure resulted in the following statements:

> *It is Gulfstream's understanding that the touch-and-go that resulted in the accident was conducted as a part of pilot training. With that understanding, please see our responses below:*
>
> *1 - What does the aircraft manufacturer have to say about the subject?*
>
> *The G200 AFM does not define a procedure or performance data for touch-and-go operations, nor is this type of operation included in the approved training, checking or currency requirements. Therefore, touch-and-go training operations on the G200 are not recommended.*
>
> *2 - If feasible, how can the pilots perform a "Touch-and-Go procedure"?*
>
> *G200 pilot training for non-routine operations is intended to be conducted in a full motion, certified simulator, not the airplane. This is particularly important for pilots new to the G200. There are many variables associated with touch-and-go operations that can impact crew workload during a phase of flight that is already considered high workload. These include runway usage during the flare with a high VREF speed, slow engine spool-up once the aircraft touches down due to the transition from flight idle to ground idle, proper flap retraction in a timely manner by the non-flying pilot (presumably in an instructor role) and the need for the pilot flying to maintain directional control throughout this transition at high speeds. Because there is no published procedure or approved performance data in the AFM for touch-and-go operations that considers these important variables, touch-and-go operations on the G200 are not recommended.*
>
> *3 - Are Touch-and-Go procedures practiced in simulators?*
>
> *Because the AFM does not define a procedure or performance data for touch-and-go operations, and they are not included in the approved pilot training curriculum, Gulfstream is not aware of any approved simulator training curriculum that includes touch-and-go procedures for the G200. If an operator chooses to work with a training provider to develop new procedures and training curriculum, coordination with the manufacturer and the applicable regulatory certification/aircraft evaluation groups is recommended. New training curriculum may also require regulatory approval depending upon the operator's type of operating certificate and the local regulations.*

According to the PIC, during the run on the ground after landing, one of the actions planned by the crew was repositioning the horizontal stabilizer trim to the takeoff position (-4.3°). Initially, the referred trim was commanded in the opposite direction to the one intended by the crew. Having noticed the mistake, the PIC started to compensate in the correct direction.

As for the distance required for landing, it was necessary to interpolate the values from the non-factored landing distance tables for 2,000 ft. and 3,000 ft., from the height of 50 ft. of the crossover point; with flaps at 40°, at a temperature of 25°C and considering the landing weight of 27,000 lb., since the airfield altitude was 2,589 ft. (Figures 9 and 10):

BACK
TOC Local
TOC Main

GULFSTREAM 200
AIRPLANE FLIGHT MANUAL

Section VII
Performance

FIGURE 7-248. UNFACTORED LANDING DISTANCE FROM 50 FT; FLAPS 40° PART B; 2000 FT

G.W. (LB)		OAT (°C)	0	5	10	15	20	25	30	35	40	45	46
		OAT (°F)	32	41	50	59	68	77	86	95	104	113	114
		MLW (LB)	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000
35,450	LFL		3814	3871	3926	3982	4039	4093	4150	4206			
	Vapp		162	162	162	162	162	162	162	162			
	Vref		152	152	152	152	152	152	152	152			
35,000	LFL		3775	3831	3886	3941	3997	4052	4106	4162			
	Vapp		160	160	160	160	160	160	160	160			
	Vref		151	151	151	151	151	151	151	151			
34,000	LFL		3688	3743	3796	3850	3904	3957	4011	4065	4118		
	Vapp		158	158	158	158	158	158	158	158	158		
	Vref		149	149	149	149	149	149	149	149	149		
33,000	LFL		3601	3653	3706	3759	3810	3863	3916	3967	4019	4072	
	Vapp		155	155	155	155	155	155	155	155	155	155	
	Vref		147	147	147	147	147	147	147	147	147	147	
32,000	LFL		3513	3565	3615	3666	3718	3767	3819	3870	3921	3970	3981
	Vapp		152	152	152	152	152	152	152	152	152	152	152
	Vref		145	145	145	145	145	145	145	145	145	145	145
31,000	LFL		3426	3474	3525	3574	3623	3673	3723	3771	3821	3870	3880
	Vapp		149	149	149	149	149	149	149	149	149	149	149
	Vref		142	142	142	142	142	142	142	142	142	142	142
MLW 30,000	LFL		3337	3385	3434	3481	3530	3578	3625	3673	3721	3768	3778
	Vapp		147	147	147	147	147	147	147	147	147	147	147
	Vref		140	140	140	140	140	140	140	140	140	140	140
29,000	LFL		3249	3296	3342	3389	3436	3481	3528	3575	3620	3667	3677
	Vapp		144	144	144	144	144	144	144	144	144	144	144
	Vref		138	138	138	138	138	138	138	138	138	138	138
28,000	LFL		3160	3205	3250	3296	3340	3386	3431	3475	3521	3566	3575
	Vapp		141	141	141	141	141	141	141	141	141	141	141
	Vref		135	135	135	135	135	135	135	135	135	135	135
27,000	LFL		3070	3115	3159	3202	3246	3290	3332	3376	3420	3462	3471
	Vapp		138	138	138	138	138	138	138	138	138	138	138
	Vref		133	133	133	133	133	133	133	133	133	133	133
26,000	LFL		2981	3022	3065	3108	3151	3192	3235	3277	3318	3360	3369
	Vapp		135	135	135	135	135	135	135	135	135	135	135

Figure 9 - Unfactored landing distance table, flaps 40º.
Source: adapted from the Gulfstream 200 AFM.

BACK
TOC Local
TOC Main

GULFSTREAM 200
AIRPLANE FLIGHT MANUAL

Section VII
Performance

FIGURE 7-250. UNFACTORED LANDING DISTANCE FROM 50 FT; FLAPS 40° PART B; 3000 FT

G.W. (LB)		OAT (°C)	0	5	10	15	20	25	30	35	40	44
		OAT (°F)	32	41	50	59	68	77	86	95	104	111
		MLW (LB)	30000	30000	30000	30000	30000	30000	30000	30000	30000	30000
35,450	LFL		3929	3988	4046	4103	4162	4219	4276			
	Vapp		162	162	162	162	162	162	162			
	Vref		152	152	152	152	152	152	152			
35,000	LFL		3890	3946	4004	4062	4118	4176	4233			
	Vapp		160	160	160	160	160	160	160			
	Vref		151	151	151	151	151	151	151			
34,000	LFL		3799	3856	3912	3967	4023	4078	4133	4189		
	Vapp		158	158	158	158	158	158	158	158		
	Vref		149	149	149	149	149	149	149	149		
33,000	LFL		3710	3763	3818	3872	3925	3980	4034	4087	4142	
	Vapp		155	155	155	155	155	155	155	155	155	
	Vref		147	147	147	147	147	147	147	147	147	
32,000	LFL		3618	3672	3725	3776	3830	3883	3934	3987	4040	4081
	Vapp		152	152	152	152	152	152	152	152	152	152
	Vref		145	145	145	145	145	145	145	145	145	145
31,000	LFL		3528	3580	3630	3682	3733	3783	3835	3886	3936	3978
	Vapp		149	149	149	149	149	149	149	149	149	149
	Vref		142	142	142	142	142	142	142	142	142	142
MLW 30,000	LFL		3437	3486	3536	3586	3635	3685	3735	3784	3834	3874
	Vapp		147	147	147	147	147	147	147	147	147	147
	Vref		140	140	140	140	140	140	140	140	140	140
29,000	LFL		3345	3394	3442	3490	3538	3587	3634	3682	3731	3768
	Vapp		144	144	144	144	144	144	144	144	144	144
	Vref		138	138	138	138	138	138	138	138	138	138
28,000	LFL		3253	3301	3347	3394	3441	3487	3534	3580	3626	3664
	Vapp		141	141	141	141	141	141	141	141	141	141
	Vref		135	135	135	135	135	135	135	135	135	135
27,000	LFL		3161	3206	3252	3297	3342	3387	3433	3477	3522	3559
	Vapp		138	138	138	138	138	138	138	138	138	138
	Vref		133	133	133	133	133	133	133	133	133	133

Figure 10 - Unfactored landing distance table, flaps 40º.
Source: adapted from the Gulfstream 200 AFM.

Unfactored values:

- V_{APP} - 138 kt;

- V_{REF} - 133 kt; and

- LFL - 3,338 ft. (1,017 m).

Regarding the situation of the flaps for landing, the *Section III*, *Abnormal Procedures*, considered that any landing configuration that did not include the *slats*, *Krueger flaps* and

flaps fully lowered (identified as DN/DN/40) required procedures to determine and correct the VREF and landing distance parameters (Figure 11):

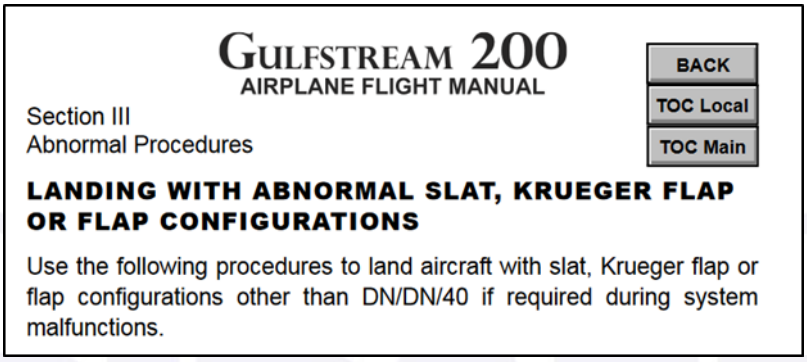


Figure 11 - Section III, Abnormal Procedures.
Source: adapted from the Gulfstream 200 AFM.

In order to apply the necessary corrections, the condition of the flaps should be framed in accordance with the table in Figure 12 below. The condition of the flaps from 20° to 39° was referenced as 25/110/20 in Table 1. Reference Configuration for *VREF and Landing Distance Corrections*, from the same section of the manual:

Table 1. Reference Configuration for Vref and Landing Distance Corrections

Cockpit Indications			Reference Configuration
Slats	**Krueger**	**Flaps**	
Not DN	Not DN	0 to 19	0/0/0
Not DN	Not DN	20 to 40*	0/0/20
DN	Not DN	40	25/0/40
DN	DN	0 to 11	25/110/0
DN	DN	12 to 19	25/110/12
DN	DN	20 to 39	25/110/20
If no indications			0/0/0
* Use only flaps 20 if slats and Krueger flaps are not DN, if able			

(Continued)

CAAI APPROVED
8 Nov 2018

III-52

Figure 12 - Table 1. Reference Configuration for VREF and Landing Distance Corrections. Source: adapted from the Gulfstream 200 AFM.

The *Table 2. VREF and Landing Distance Corrections for Abnormal Configurations* provided the following corrections for the landing condition with flaps between 20° and 39° with an aircraft weight of 27,000 lb. (Figure 13):

Table 2. Vref and Landing Distance Corrections for Abnormal Configurations.

Reference Configuration Slats/KF/Flaps	Landing Distance Correction	Gross Weight (1000 lb) Vref								
		30	29	28	27	26	25	24	23	22
0/0/0	100%	194	192	188	184	182	178	174	170	166
0/0/20	50%	172	168	166	162	160	156	154	150	146
25/0/40	15%	148	146	142	140	138	134	132	130	126
25/110/0	35%	157	154	151	148	145	142	139	136	134
25/110/12	25%	147	145	141	139	136	133	130	128	125
25/110/20	25%	142	140	138	134	131	129	126	123	120

NOTE

Shaded Vrefs exceed maximum tire speed
(Sea Level standard conditions, no wind)

Figure 13 - Table 2. VREF and Landing Distance Corrections for Abnormal Configurations. Source: adapted from Gulfstream 200 AFM.

Applying these corrections to the previously mentioned values would result in:

- V_{APP} - 138 kt;

- V_{REF} - 134 kt; and

- LFL - 4,172 ft. (1,271 m).

The EGPWS provided aural warnings identified in the CVR recordings as "*Too Low Terrain*" and "*Too Low Flaps*," which were triggered at approximately 200 ft. AGL and 100 ft. AGL, respectively.

Figure 14 below provides a brief description of the EGPWS operating mode 4B to clarify why the "*Too Low Terrain*" and "*Too Low Flaps*" alarms sounded in the cockpit:

Mode 4A

Mode 4A is active during cruise and approach with gear not in landing configuration. Warnings for mode 4A activate the red **PULL UP** display on the PFD and the aural message "TOO LOW GEAR", or if airspeed is greater than 190 KIAS, "TOO LOW TERRAIN". These messages will only be repeated twice unless terrain clearance continues to decrease.

Mode 4B

Mode 4B is also active during cruise and approach, but with gear in landing configuration. Warnings for Mode 4B activate the red **PULL UP** display on the PFD and the message "TOO LOW FLAPS", or if airspeed is greater than 159 KIAS, "TOO LOW TERRAIN". These messages will only be repeated twice unless terrain clearance continues to decrease.

(Continued)

CAAI APPROVED
8 Mar 2006 VI-9-13

Figure 14 - Page VI-9-13, EGPWS "*Too Low Terrain*" and "*Too Low Flaps*" warnings. Source: Adapted from Gulfstream 200 AFM Supplement 9.

1.19. Additional information.

Stabilized approach concept.

The Supplementary Instruction (*IS*) 91-003, Rev. A, dated 02 October 2014 and valid at the time of this occurrence, defined "*stabilized approach*" as follows:

> 5. DEFINITIONS
>
> 5.1 This Supplementary Instruction utilizes some of the terms and definitions in the English language because it is understood that they are already widely used by the industry and operators.
>
> 5.2 Within the scope of this *IS*, all definitions contained in the RBAC-01, in the RBHA-91, or in the RBAC that will eventually replace it, are valid.
>
> 5.3 *Stabilized approach*. An approach performed in a controlled and appropriate manner in terms of configuration, energy, and flight path from a predetermined height up to 50 feet above the threshold or the point where the flare maneuver is initiated.

In item 15.3, the same *IS* also included the following on the subject of "*stabilized approach*":

> 15. ILS CAT I AR APPROACHES
>
> [...]
>
> 15.3 The stabilized approach concept is widely used by the industry with the purpose of reducing the risk of accidents or incidents during approaches, as well as reducing the probability of missed approach procedures when the aircraft is at low altitude. The objective is to have the aircraft properly configured, at the appropriate speed and trajectory for landing before a predetermined point. When in instrument flight conditions (IMC), this *IS* considers 1,000 (one thousand) feet AGL as the minimum height for stabilizing the approach.

According to the Flight Safety Foundation, for an approach to be considered stabilized, the aircraft should be at least 1,000 ft. AGL of the airport in IMC and 500 ft. AGL of the airport in VMC, as well as meeting the following criteria:

- ✓ aircraft on the correct flight path;
- ✓ only minor changes in heading/pitch necessary to maintain the correct flight path;
- ✓ indicated airspeed not exceeding V_{REF} + 20 kt and not less than V_{REF};
- ✓ aircraft in the correct landing configuration;
- ✓ descent rate not exceeding 1,000 ft./ min; if an approach requires a sink rate greater than 1,000 ft./ min, a special briefing must be conducted;
- ✓ power setting appropriate for the aircraft configuration and not below the minimum power for the approach as defined in the operating manual;
- ✓ all briefings and checklists have been completed; and
- ✓ an approach that becomes unstable below 1,000 ft. AGL of the airport in IMC or 500 ft. AGL of the airport in VMC requires an immediate go-around.

1.20. Useful or effective investigation techniques.

NIL.

2. ANALYSIS.

It was a local IFR training flight with touch and goes, with two pilots and an extra crew member on board.

According to the data gathered by the Investigation Committee, the aircraft was within the weight and balance limits specified by the manufacturer and there were no pre-existing technical conditions that could have contributed to the occurrence.

Despite being a night IFR training flight, the weather conditions were favorable for visual flights.

The pilots were qualified, and the flight was intended to be part of the process of revalidating the type rating of the pilots involved in the accident.

The aforementioned training was based on the Ordinance nº 1539/SPO, which recognized alternative procedures for the conduction of training and examinations provided for in the Brazilian Civil Aviation Regulation nº 61 (RBAC-61) for revalidation of ratings.

It is important to emphasize that, although the pilots had a father-son relationship, no evidence was found to support the theory that such a relationship had interfered with their performance onboard the aircraft, taking into account what was observed at the interviews and according to the testimony given by the third crew member that was on board on the occasion of the occurrence.

The internal communications that were recorded corroborate this finding, since the treatment between the pilots was considered to be professional by the Investigation Committee.

Therefore, with regard to the airworthiness conditions, weather conditions, or crew qualifications, there were no indications of anything that could have affected the operational performance of the flight.

The aerodrome was suitable for the operation of that type of aircraft. The instrument approach aid available for runway 13 of SBBH was a LOC/DME type. This type of aid only provided indication of the approach course for the threshold of runway 13 and, according to the additional information contained in the ADC, runway 13 had a PAPI visual indicator of a 3.8º-slope, but it was not evident from the pilots' statements whether they used the indications of this latter visual aid.

Based on the records of the communications between the PR-AUR crew and the control agencies, it was found that there were no technical abnormalities of any type in the communication equipment during the flight.

The pilots reported that, before boarding, they held a briefing on the sequence of maneuvers that would be performed, conducted the preparatory procedures for the flight, and consulted the available meteorological information in addition to official aeronautical information.

With regard to the maneuvers planned for the training, it should be noted that Section IV of the AFM, which dealt with normal procedures, did not include touch-and-go landings.

The sequence of actions in performing this maneuver was agreed by the crew. It did not become clear at what point the pilots decided to use the flaps at 20° for landing, in discordance with the angle stipulated in the AFM (40°).

Thus, it was observed that, as the touch-and-go procedure was not found in the AFM, the crew decided to improvise the actions in order to carry out the maneuver.

In a consultation with the manufacturer, one verified that it was not recommended to perform this type of training using the aircraft. It was also reported that there was no provision for this type of maneuver using flight simulators and that, if the operator so desired, they should develop a new training curriculum, in coordination with the manufacturer and in accordance with the applicable regulations.

The manufacturer also mentioned, in the response to the consultation by the CENIPA, that performing touch-and-go landings involves many variables that increase the workload of the crew members in a critical phase of the flight and can impact the crew's performance.

Thus, the Investigation Committee concluded that the improvisational attitude, associated with the increased self-imposed workload, may have led to the inadequate handling of the flight controls, characterized by the aircraft's elevator trim positioning on the wrong side, which may have made the aircraft departure after the touchdown unfeasible, contributing to the PR-AUR's runway excursion.

According to calculations made by the Investigation Committee, the runway distance required to make a complete landing would be 1,271 m for that condition of the flaps (20º). Thus, considering the length of the runway, there would still be approximately 1,093 m available for the aircraft to stop. However, it is important to mention that, when passing over the threshold, the aircraft was still operating at a speed of 140 kt, that is, above the prescribed VREF, which was 134 kt. for that configuration (or 138 kt., considering the information given by the PIC).

Since the flight had its origin and destination in the same location and the pilots were not familiar with the touch-and-go procedure, there was little time to perform all the necessary checks, considerably increasing the workload on board the PR-AUR aircraft before they started the LOC RWY 13 procedure.

In this context, one concluded that the flight preparation was not adequately performed, since the planning did not allocate enough time for the pilots to prepare the aircraft for the return and the carry-out of the procedure, culminating in an unstabilized approach, which contributed to the outcome of the occurrence.

Moments after receiving clearance to climb and maintain 8,000 ft., the PR-AUR was authorized to proceed directly to the *ERVIM* position, which was the IAF for the LOC RWY 13 procedure of SBBH.

The PM requested descent clearance from the APP-BH, and was initially authorized to descend to 7,000 ft. The PF began the descent while the PM was busy with the *before-landing* checks.

Subsequently, the APP-BH cleared the aircraft for the LOC RWY 13 instrument approach procedure of SBBH. At that time, the items on the checklist were worked, and the aircraft was prepared for the approach, with the PM noting that the aircraft could end up in a "*high and fast*" condition.

The realization that there was little time to prepare the aircraft and that they were entering an unstable final condition was made clear when the PIC reported to the control unit that the aircraft was stabilized on final and with the runway in sight; however, it was necessary to alert the SIC to place the aircraft in a descent at the risk of "*not landing*", which led the SIC to employ a higher descent rate of approximately 2,200 ft./ min, that is, well beyond the 750 ft./ min prescribed.

In this high workload scenario, the SIC's lack of experience contributed to an approach outside the prescribed height and speed parameters for that moment of the flight in which, even under the PIC's guidance, the aircraft reached the indicated speed of 181 kt with the power levers fully reduced.

One may consider that, although the PIC had approximately 7,000 total flight hours, 200 hours of which on that aircraft, he had also never performed this type of procedure (touch-and-go landings) using that model of aircraft, something that also contributed to the occurrence.

The recordings showed that, despite the PM's information to the PF that the aircraft was to maintain a VREF of 138 kt (although the Investigation Committee calculated a VREF value of 134 kt), that speed, in practical terms, was reached moments before landing. In addition, one observed several moments in the recordings in which the aircraft was at a high rate of descent and with the throttles fully reduced during the final approach.

The manuals and aeronautical publications dealing with the subject of stabilized approach recommended that discontinuing the approach and going around would be the most conservative and appropriate decision to preserve flight safety.

Therefore, the decision to continue the approach showed that the pilots had difficulty recognizing that they were dealing with an unstabilized approach situation, and

demonstrated the crew's low situational awareness of the risks associated with continuing the landing under those operating conditions.

This attitude of acceptance of the errors committed at the end of the procedure, and the persistence in continuing the approach under marginal safety conditions also reflected difficulties in the way both pilots thought and acted, leading to inappropriate attitudes of complacency, improvisation, and disregard of operating procedures, probably due to overconfidence.

Still according to the PIC, when he deemed that there would not be enough runway length to complete the touch-and-go maneuver after having touched down due to the incorrect trim setting, he chose to abort the takeoff and began assisting the SIC in applying the flight controls in the attempt to stop the aircraft.

From the recordings, however, one cannot determine the exact moment at which the PIC chose to abort the takeoff run after the touchdown, or which of the pilots was actually operating the aircraft controls. It was observed that there was no clear and assertive communication between the pilots after the aircraft touched down on the runway.

The sequence of events which followed corroborates the conclusion that there was little definition of tasks on board. Only when the aircraft was in the final one-third of the runway, at an indicated speed of 114 kt., were the thrust levers moved to the *MAX T/R* position and were the brakes applied with greater amplitude.

This denoted that the cockpit coordination, especially in the final moments of the flight, contributed to the inefficiency of the human resources during that operation due both to inadequate management of the tasks assigned to each crew member and to poor communication.

The Investigation Committee also considered that poor communication contributed to the lack of effectiveness in the handling of the controls (application of brakes and *MAX T/R*) for stopping the aircraft, contributing to the consequent overrun of the runway longitudinal limits.

In relation to piloting judgment, one observed that the attempt to abort the departure occurred after the aircraft had reached 147 kt., a value well above the decision speed of 112 kt. configured in the FMS, and without sufficient runway distance remaining for that matter.

Therefore, one considered that there was an inadequate assessment of the parameters related to the operation of the aircraft, leading to the runway excursion.

3. CONCLUSIONS.

3.1. Findings.

a) the pilots had valid Aeronautical Medical Certificates (CMA);

b) the pilots had valid ratings for G200 type aircraft (which included the Gulfstream 200 model) and Instrument Flight - Airplane (IFRA);

c) the pilots were qualified, and were performing touch-and-go training for the first time in that type of aircraft;

d) the PIC had 7,000 total flight hours, 200 hours of which in the aircraft type;

e) the SIC had 225 hours and 30 minutes total flight time, 67 hours and 5 minutes of which in the aircraft type;

f) the pilots had never performed touch-and-go maneuvers with that model of aircraft before;

g) the aircraft had a valid CVA (Airworthiness Verification-Certificate);

h) the aircraft was within the prescribed weight and balance limits;

i) the records of the airframe and engine logbooks were up to date;

j) the weather conditions were above the minimums for the flight;

k) no anomalies or failures were identified in the operation of the aircraft systems that could have compromised its control and/or operation;

l) no technical abnormalities were identified in the communication equipment during the flight;

m) the aircraft performed an unstabilized final approach;

n) after touching down, the aircraft was trimmed to pitching down, instead of pitching up;

o) there was an attempt of a new departure after touchdown but it was aborted;

p) the throttles were reduced to abort the takeoff at an indicated speed of 147 kt.;

q) the aircraft overran the departure end of the runway 13;

r) the aircraft sustained substantial damage; and

s) the PIC suffered minor injuries, whereas the SIC and the extra crew member were not injured.

3.2. Contributing factors.

Attitude – a contributor.

The contribution of the pilots' attitude to the outcome of this occurrence can be found in two distinct moments: when the go-around procedures were improvised, and when the approach was continued under marginal safety conditions, reflecting difficulties in the way the crew thought and acted.

Communication – a contributor.

One considered that the lack of clear and assertive communication between the pilots at the time of the decision to abort the takeoff, and the lack of definition as to which pilot had the aircraft controls in that moment contributed to the aircraft exceeding the departure end of the runway.

Crew Resource Management – a contributor.

The lack of adequate management of the tasks performed by the pilots during the transition to the takeoff run after the touch-down, a critical moment of the flight, combined with the lack of clear communication between them contributed to the inadequate handling of the aircraft on the ground and its consequent runway excursion.

Handling of aircraft flight controls – a contributor.

The ineffective control inputs during the final approach and during the attempt to stop the aircraft after touchdown, as well as the application of the elevator trim to the opposite side after the touchdown on the runway, indicated inadequacies in the handling of the controls that contributed to the airplane's runway excursion.

Piloting judgment – a contributor.

An inadequate assessment of the parameters related to the aircraft's operation was observed when there was an attempt to abort the takeoff after the airplane had reached 147 knots, without evaluating the remaining runway length to ensure full stop of the aircraft within the runway limits.

Flight planning – a contributor.

One concluded that the flight preparation was not adequately executed, as the planning did not allocate enough time for the pilots to prepare the aircraft for the return and carry-out of the descent procedure, resulting in an unstable approach.

4. SAFETY RECOMMENDATIONS

None.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On September 24th, 2024.