COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
IG - 065/CENIPA/2018

OCCURRENCE:	**SERIOUS INCIDENT**
AIRCRAFT:	**PR-GTN and FAB 2345**
MODEL:	**737-8EH and C-95M**
DATE:	**10APR2018**

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 taking into account 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 different 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 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. Taking into account 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 10APR2018 serious incident with the 737-8EH aircraft, registration PR-GTN and FAB 2345, model C-95M. The serious incident was classified as “[RI] Runway Incursion”.

During the take-off run, the PR-GTN pilots identified that a Brazilian Air Force (FAB) aircraft, which had just landed, was still on the runway. The PR-GTN aircraft takeoff occurred with the runway occupied by the FAB aircraft.

The aircraft were not damaged.

The occupants of both aircraft left unharmed.

An Accredited Representative of the National Transportation Safety Board (NTSB) - USA, (State where the 737-8EH aircraft was designed/manufactured) was designated for participation in the investigation

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GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

ADC	Aerodrome Chart
AFA	Air Force Academy
AIC	Aeronautical Information Circular
ANAC	Brazil's National Civil Aviation Agency
ATS	Air Traffic Services
B739	B739 aircraft Rating (which included model 737-8EH)
CA	Airworthiness Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CI	Investigation Team
CLRD-BR	Brasilia Clearance Delivery
CVI	Instrument Flight Card
CVR	Cockpit Voice Recorder
DECEA	Air Space Control Department
DTCEA-BR	Brasília Air Space Control Detachment
ETA3	Third Air Transport Squadron
FAB	Brazilian Air Force
FDR	Flight Data Recorder
GNDC-BR	Brasilia Ground Control
ICA	Aeronautics Command Instruction
IFR	Instrument Flight Rules
IFRA	Instrument Flight Rating - Airplane
MCA	Aeronautics Command Manual
METAR	Aviation Routine Weather Report
NTSB	National Transportation Safety Board (USA)
PLA	Airline Pilot License – Airplane
PN	Part Number
PPR	Private Pilot License – Airplane
SBBR	ICAO Location designator - Presidente Juscelino Kubitschek International Airport, Brasília - DF
SBSC	ICAO Location designator – Santa Cruz Aerodrome, Rio de Janeiro - RJ
SBSL	ICAO Location designator – Marechal Cunha Machado Aerodrome, São Luis - MA
SMR	Surface Movement Radar
SN	Serial Number
SSFDR	Solid State Flight Data Recorder
TPR	Aircraft Registration Category of Regular Public Transport
TRM	Team Resource Management
TWR-BR	Brasilia Aerodrome Control Tower - DF

UAe	Air Unit
UTC	Universal Time Coordinated
VMC	Visual Meteorological Conditions

1. FACTUAL INFORMATION.

Aircraft	**Model:** 737-8EH and C-95M **Registration:** PR-GTN and FAB 2345 **Manufacturer:** Boeing Company and EMBRAER	**Operator:** *Gol Linhas Aéreas S.A.* and Brazilian Air Force
Occurrence	**Date/time:** 10APR2018 - 0032 UTC **Location:** Presidente Juscelino Kubitschek International Airport (SBBR) **Lat.** 15°52'16"S **Long.** 047°55'07"W **Municipality – State:** Brasília – DF	**Type(s):** [RI] Runway Incursion **Subtype(s):** NIL

1.1 History of the flight.

The PR-GTN aircraft took off from the Presidente Juscelino Kubitschek International Airport (SBBR), Brasília - DF, to the Marechal Cunha Machado Aerodrome (SBSL), São Luís - MA, at approximately 0030 (UTC), in order to perform a regular passengers flight, with six crewmembers and 154 passengers on board.

The FAB 2345 aircraft had taken off from the Santa Cruz Aerodrome (SBSC), Rio de Janeiro - RJ, to SBBR, in order to carry personnel, with three crewmembers and five passengers on board.

During the takeoff run of the Boeing 737, at SBBR, the Brazilian Air Force (FAB) aircraft that had just landed was identified, still on the runway.

The civil aircraft took off passing over the military aircraft.

The aircraft were not damaged.

The occupants of both aircraft left unharmed.

1.2 Injuries to persons.

PR-GTN

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	6	154	-

FAB 2345

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	3	5	-

1.3 Damage to the aircraft.

None.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

PR-GTN

Flight Hours		
	Pilot	Copilot
Total	19.700:00	9.100:00
Total in the last 30 days	89:45	65:05
Total in the last 24 hours	04:00	04:00
In this type of aircraft	7.734:40	7.655:20
In this type in the last 30 days	89:45	65:05
In this type in the last 24 hours	04:00	04:00

N.B.: The data relating to the hours flown were obtained through information from the airline operator of the aircraft and supplemented by the crewmembers themselves.

FAB 2345

Flight Hours		
	Pilot	Copilot
Total	479:50	367:25
Total in the last 30 days	27:20	18:55
Total in the last 24 hours	02:50	02:50
In this type of aircraft	347:05	228:00
In this type in the last 30 days	27:20	18:55
In this type in the last 24 hours	02:50	02:50

N.B.: The data relating to the hours flown were obtained through the registers of the Air Unit Statistics Section (UAe).

1.5.2 Personnel training.

The PR-GTN aircraft pilot took the PPR course at the Guaxupé Aeroclub - MG, in 1988.

The PR-GTN aircraft copilot took the PPR course at the *Faculdade de Ciências Aeronáuticas* of the PUCRS - RS, in 2004.

The FAB 2345 aircraft pilot graduated at the Air Force Academy (AFA), in 2014.

The FAB 2345 aircraft copilot graduated at the Air Force Academy (AFA), in 2015.

1.5.3 Category of licenses and validity of certificates.

The PR-GTN aircraft pilots had the PLA License and had valid B739 type aircraft (which included model 737-8EH) and IFRA Ratings.

The FAB aircraft crewmembers had valid CVI.

1.5.4 Qualification and flight experience.

The pilots were qualified and had experience in that kind of flight.

1.5.5 Validity of medical certificate.

The PR-GTN aircraft pilots had valid CMAs.

The FAB 2345 aircraft pilots had their health inspections valid.

1.6 Aircraft information.

PR-GTN:

The aircraft, serial number 34267, was manufactured by the Boeing Company, in 2007 and it was registered in the TPR category.

The aircraft had valid Airworthiness Certificate (CA).

The technical maintenance records were updated.

FAB 2345:

The military designation aircraft C-95M (EMB-110), serial number 110.361, was manufactured by the Embraer in 1981 and belonged to the FAB.

The technical maintenance records were updated.

The last inspection of the aircraft, the "55-H1" type, was carried out on 26FEB2018, in the ETA3, in Rio de Janeiro - RJ, having flown 106 hours and 35 minutes after the inspection.

1.7 Meteorological information.

The conditions were favorable for the visual flight.

The SBBR METAR provided the following information:

METAR SBBR 100000Z 12002KT 9999 FEW040 BKN100 19/17 Q1019=

METAR SBBR 100100Z 12006KT 9999 FEW040 BKN070 19/17 Q1019=

It was verified, therefore, that near the time of the occurrence, the visibility was over 10km and the estimated ceiling was between 7,000ft and 10,000f.

1.8 Aids to navigation.

Nil.

1.9 Communications.

According to the transcriptions of the audios obtained through the air traffic control bodies, it was verified that there was no technical abnormality of communication equipment between the aircraft and the air traffic controllers.

In order to base the analysis on the sequence of events that preceded the aeronautical occurrence, the Investigation Team highlighted some transmissions that could help in understanding the dynamics of the serious incident.

For the record of the schedules described in this field, the Coordinated Universal Time (UTC) was used as reference, as follows:

At 00h26min30s, the Brasilia Tower controller (TWR-BR) authorized the landing of the Brazilian Air Force aircraft (FAB 2345) on runway 11L.

At 00h29min31s, after the FAB 2345 landing, the TWR-BR authorized the PR-GTN to align and maintain.

At 00h30min23s, when controlling the aircraft after the landing, the crew of the FAB 2345 issued the following message:

> "Brasilia Tower, is it clear ... to cross on ... on "Charlie" to the military apron?" (our emphasis).

At 00h30min33s, the Tower passed the following authorization:

> "Pioneer 45 (call code of FAB 2345), clear on "Golf" and call the Ground on frequency 121.8." (our emphasis).

At 00h30min37s, the FAB copilot read back the received message in a synthesized way, as follows:

> "Golf, will call Ground, 121.8".

At 00h30min49s, the TWR-BR controller authorized the PR-GTN take-off that was already aligned on the 11L threshold.

At 00h30min53s, at the frequency of the Brasilia Ground Control (GND-BR), the FAB 2345 crew reported to the Ground controller that it would clear on the main runway through Taxiway (TWY) "G" (Golf) to proceed to the military apron, according to the following transcription:

> "Brasilia Ground, good evening! Pioneer 45 landed on 11L. It will clear on the "Golf" to the military apron". (our emphasis).

At 00h30min59s, the GND-BR reported that it was aware and authorized the taxi of the aircraft to the military apron.

At 00h31min49s, the FAB 2345 crew rectified the initial message passed to the GND-BR, requesting to clear the main runway by TWY "F" (Foxtrot).

At 00h31min54s, the GND-BR authorized the FAB aircraft to clear the runway by TWY "F" (Foxtrot), as well as the taxi to the military apron.

At 00h32min32s, the PR-GTN crew made a call on TWR-BR frequency, reporting that their takeoff had occurred with the runway still occupied by the FAB aircraft.

1.10 Aerodrome information.

The aerodrome was public, ran by INFRAMERICA and operated under Visual Flight Rules (VFR) and by Instruments (IFR), in daytime and nighttime.

The runway was made of asphalt with 11L/29R thresholds, dimensions 3,300m x 45m, with elevation of 3,497 feet (Figure 1).

Figure 1 - Satellite image (Google Earth) presenting the SBBR overview.

1.11 Flight recorders.

The PR-GTN aircraft was equipped with a Honeywell Flight Data Recorder (FDR), SSFDR model, Part Number (PN) 980-4700-042, Serial Number (SN) 5787, with the capacity of 256 words (each word has 12 bits), thus doing a reading of 256 x 12 every second (words per second).

In addition, it was equipped with a Cockpit Voice Recorder (CVR) L-3, model FA2100 (solid state memory), PN 2100-1020-00, SN 00657, with the capacity of two hours of

recording, featuring four channels of thirty minutes in high quality and two standard quality channels with two hours of audio.

Only the flight data recorder could be used for investigation purposes because, due to the continued operation of the PR-GTN, the voice recordings related to the moment of the serious incident were over recorded.

The FAB 2345 aircraft was equipped with a Cockpit Voice Recorder (CVR) L-3, model FA2100, PN 2100-1010-00, with a recording capacity of 30 minutes, with four channels.

However, because it continued to operate after the incident, the information contained in the FAB 2345 Bandeirante CVR, as well as in the PR-GTN, were also over recorded, making it impossible the utilization of the respective content for the investigation.

1.12 Wreckage and impact information.

Nil.

1.13 Medical and pathological information.

1.13.1 Medical aspects.

No evidence was found that problems of physiological nature could have affected the flight crew performance.

1.13.2 Ergonomic information.

Several aspects related to ergonomics were identified during the investigation of this serious incident, mainly, issues related to the working conditions of the Brasilia Tower controllers.

The Investigation Team identified several physical barriers that prevented the direct visualization of the aircraft in certain positions in the area of movement in SBBR from the positions line of sight of the Tower, besides having verified the negative influence of the illumination of the aprons, known as North Pier and South Pier, which contributed to the blurring of TWR-BR controllers.

All these aspects will be covered in detail in this report as they are listed, so as to avoid excessive repetition of information.

1.13.3 Psychological aspects.

PR-GTN Technical Crew:

The commander and the copilot considered themselves to be experienced and discerning professionals on the flight. The copilot was described by the commander as a calm, sensible, quiet, and mature professional.

According to the judgment of the commander, the copilot performed correctly all the tasks relevant to the flight.

The serious incident occurred on the second flight stage of the day.

Immediately after the serious incident, when the copilot made contact with the Tower to report that he had flown over an aircraft on the runway, the crew noticed from the tone of voice of the controller that he had not realized that he had just authorized a take-off with the runway still occupied by another aircraft.

According to the perception of this same crew, after being informed by them about what happened, the controller showed surprise. The pilots considered that a good cabin management was performed.

Although these were the first stages they performed together, they concluded that they had a good interaction in flight and that they made the difference in the scenario, avoiding an accident with catastrophic potential.

FAB 2345 Technical Crew:

The commander had already landed in Brasilia on other occasions, and for that reason he was familiar with the operation in that locality, and even operated at night.

The copilot showed up for the mission at 1700 (UTC), after a good rest period, as reported. She did not consider herself fully familiar with the SBBR operation, for that would be her first night landing in that locality.

The flight mechanic also showed up for the mission at 1700 (UTC). He considered himself familiar with the operation in Brasilia, having already operated relatively frequently in that locality. He reported that the Brasília Aerodrome had, in his perception, bad lighting, which made it difficult to identify taxi runways at night.

The fatigue control used by ETA3 prevised the release in the administrative tasks, and the crew should only present for the mission, since the flight was scheduled for 2000 UTC on 09APR2018.

Therefore, even with the one hour and forty minutes delay in SBSC take-off, which occurred at 2140 (UTC), the crew reported that this did not cause any discomfort to the flight.

According to the FAB 2345 commander, after landing, with the aircraft already controlled and with the intention of clearing the runway quickly, he guided the copilot to make contact with the Tower, since the controller had not yet done so, according to the habitual.

When he looked for the nearest intersection of the runway, he saw the vertical sign with the name of taxiway, in which he saw the letter "C".

He therefore instructed the copilot to ask the Tower controller to clear the main runway by that intersection that he believed to be TWY "C" (Charlie).

After receiving directions from the Tower, the copilot reported that he thought he had performed the frequency change for GND-BR on a timely basis.

The commander had flown an average of three to four times with the copilot and, in his view, there were no relationship barriers in the cabin.

According to information collected, the aircraft commander was considered a pilot dedicated to work, with good preparation and overall performance considered normal.

The copilot was seen by her peers and superiors as an "above average" professional because of her dedication to flying studies.

FAB 2345 Passengers:

According to the passengers of the FAB 2345, the take-off, the cruise flight and the landing happened normally, not being identified any discrepancy. They reported that there was no rush for the departure of the SBSC flight.

After landing, before clearing the runway, they heard an intense noise and felt a strong vibration in the aircraft that they associated with a go-around procedure of another airplane at low altitude.

Air Traffic Controllers:

The controller who was in the supervisory position had nineteen years of service.

On the day of the serious incident, the supervisor made the planned briefing, which took approximately fifteen minutes, when the conditions of the runway and meteorology

were approached and where all the staff was consulted about the physical and psychological conditions for take over the service.

During the service, the supervisor focused attention on less experienced controllers for the task.

According to him, the flow of aircraft was consistent with the schedule, that is, the movements were around forty traffics per hour, which was considered a low intensity flow.

The FAB 2345 was the only aircraft to land at that time, so for him there was no need for a more alert attitude, unlike what happens when there is heavy traffic.

Due to his position at the duty station, the supervisor had a poor view of the aircraft apron, which was aggravated at nighttime.

According to the supervisor, he realized that something had probably gone wrong by the tone of the PR-GTN pilot's voice contacting the Tower after takeoff.

He immediately approached the console and heard, along with the TWR-BR controller, the pilot informing that his take-off happened with the FAB 2345 still on the runway. Until that moment, the Tower controller was calm in his position, because he believed that the FAB 2345 had cleared the runway by TWY "G" (Golf).

After the contact of the aircraft that had just taken off, the supervisor verified the situation with the controller that was in the Ground position, receiving confirmation that the FAB 2345 had just entered TWY "F" (Foxtrot).

Immediately, he replaced the controller of the Tower position, according to the operational procedures. However, he did not replace the Ground position controller.

The controller that was operating in the TWR-BR position had six years of service.

He showed up for work at 1700 (UTC) and attended the supervisor’s briefing for the beginning of the workday. His first shift began at around 1900 (UTC) in the North Tower position (position that controls the traffic for runways 11L and 29R), in which he instructed a trainee controller from another organization. This shift was extended until 2000 (UTC).

After the regulatory break, he began, at 2230 (UTC), the second shift that would last until 2400 (UTC).

On that occasion, it was expected that he would surrender another controller in the Clearance Delivery (CLRD-BR) position, but due to the adjustments made in accordance with the stage, he had to operate again in the North Tower position.

At the time of the serious incident, the controller was already in position for about an hour and fifteen minutes. According to reports, he presented a tiredness considered normal for an end of shift.

On the communication with the FAB 2345, he reported that, in the first contact after landing, he did not understand what the copilot had said.

The controller was not expecting a call from the aircraft after landing and, according to his perception, the copilot spoke a little quickly, making it difficult to understand the message.

It should be noted that normally, after landing, at a controlled aerodrome, the first radio contact is performed by the Tower, not by the aircraft.

From his experience, the Tower controller inferred that it was a "ground controlled" message. Therefore, he continued guiding the aircraft to leave on the TWY "G" (Golf) and call the Ground at the respective frequency. After that moment, his focus of attention turned to the PR-GTN take-off.

Accordingly, the controller made a brief visual scan, and since he did not see the FAB 2345, he concluded that it had cleared the runway, since that aircraft was already very close to TWY "G" (Golf), at the moment the runway clearance was authorized.

The number of lights on the aerodrome hampered the identification of the aircraft on the runway at night.

There was also a difficulty with the night view of camouflaged aircraft without stroboscopic lights, as it was the case with the FAB 2345.

The controller operating in the Ground position was active in this activity from the year 2014 and considered the shift to be normal until the moment of the serious incident. For him, the FAB 2345 would have cleared the runway on the TWY "G" (Golf) and would go by the TWY "H" (Hotel) to the military apron, as was the routine for military aircraft.

From his workstation, physical barriers made it difficult to see the TWY "H" (Hotel) and the military apron.

As he considered that the FAB 2345 would go towards the military apron, he returned his focus of attention to the control of other aircraft.

With the contact of FAB 2345, requesting to clear on the TWY "F" (Foxtrot), he realized that the aircraft was not in the military apron, as expected.

1.14 Fire.

There was no fire.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

Nil.

1.17 Organizational and management information.

PR-GTN Operator Airline:

The PR-GTN operating company was in a good time, with a mature organizational culture and low professionals turnover, according to the perception of its pilots.

The company granted the commander autonomy to make decisions regarding the flight.

The crew considered the trainings offered by the company excellent.

The commander performed his simulator training in December 2017 and the copilot took part in a simulator training the week before the incident.

The company's Safety Directorate did not act with punitive practices.

FAB 2345 Operator Air Squadron:

The squadron had undergone a restructuring that began in late 2017, in which the pilots from another organization had joined the original crew group. In addition to these pilots, the UAe also received mechanics sent from eight other FAB units.

It was reported that it was customary in the Squadron to anticipate the frequency shift to the Ground Control even before clearing the runway in use after landing.

The crew-training program had been completed as planned by the organization.

The commander of the aircraft involved in the serious incident had been trained in the month prior to the serious incident, which consisted of an on-going readaptation flight, in

which he performed quite satisfactorily, in accordance with the pattern observed in all his Flight Sheets.

The copilot underwent instrument flight training also in the month prior to the serious incident.

At the time of the incident, the working conditions in the Squadron involved an intense volume of flight, due to the great amount of operational missions to fulfill.

With regard to flight safety, briefings were held on a weekly basis, in which subjects related to accident prevention were passed on.

According to the reports obtained, there was a good interaction among all the staff of the organization.

Air Traffic Control Body:

Within the air traffic control body, Team Resource Management (TRM) trainings were offered, and these were considered adequate.

As for the working conditions of the controllers in the Control Tower, regarding the blind spots in the aerodrome, there were no specific procedures aimed at performing the monitoring of the aircraft.

1.18 Operational information.

The FAB aircraft was fueled and prepared within all operational limits for carrying out a military transport mission in the leg from SBSC to SBBR.

The plane took off at 2140 (UTC) and the flight ran without any abnormalities until landing on the 11L runway, in Brasilia.

Still on a cruise flight, the commander of the military aircraft performed the approach and landing briefing, defining, among other points, that after the touchdown, he would control the aircraft, dosing the brakes in order to clear the main runway by TWY "F" (Foxtrot).

However, when landing, the pilot effectively used the reverse and brake controls, managing to control the aircraft in a position previous to the one in which he had defined as the ideal to clear the runway.

In this way, the pilot began directing the aircraft in a parallel shift to the right of the centerline, already preparing the aircraft to clear the runway in use by that approaching exit intersection.

Looking quickly to the right, the commander noted the vertical marking on the side of the TWY, indicating the letter corresponding to that position by which, now, it would clear the runway, despite having previously combined with the copilot another position for abandoning the main runway.

As reported, the FAB 2345 pilot visualized the letter "C" on the taxiway's signposting plate and therefore asked the copilot (crewmember responsible for communications) to ask the TWR-BR to authorize them to clear the runway by the TWY "C" (Charlie).

In response to the crew of the military aircraft request, the TWR-BR controller directed the aircraft to clear on the TWY "G" and call the Ground control.

After receiving the message from the Tower, the FAB 2345 crew decided not to clear the runway in that position where the aircraft was already moving, switched the frequency to the GND-BR channel and remained on the main runway until the next exit intersection.

The military crew made initial contact with the GND-BR while still taxing on the main runway toward the next exit intersection and reported on that frequency that it would clear the runway through the TWY "G" (Golf).

The controller (GND-BR), in turn, only reported that he was aware and authorized the taxi of the aircraft to the military apron.

By identifying, through reading the runway vertical signaling, that the next intersection was TWY "F" (Foxtrot) and not TWY "G" (Golf), the crew rectified the message they had passed to the GND- BR, requesting to clear the runway by TWY "F" (Foxtrot).

Once again, the controller (GND-BR) authorized the departure of the aircraft from the main runway and the taxi to the military apron.

Figure 2 shows an air image of the used runway with the indication of the mentioned exit intersections.

Figure 2 - Satellite image (Google Earth) of SBBR 11L runway and indications of TWY C (Charlie), G (Golf) and F (Foxtrot).

As the aircraft began to position itself toward TWY "F" (Foxtrot) to clear the runway, the occupants of that military aircraft suddenly perceived a very intense light coming from outside, accompanied by an extremely loud noise and a strong vibration.

As they looked out the window, some of the crew and passengers sighted the commercial plane that had just passed over the C-95M that still occupied the main runway.

Looking at the event now from the perspective of the Boeing 737, registration PR-GTN, it had also been fueled and prepared within all weight and balance operating limits for the fulfillment of a regular passenger transport flight from SBBR to SBSL.

All procedures happened without any abnormalities until the aircraft was waiting for the landing of the FAB 2345, in order to be able to takeoff from the Brasilia runway 11L.

The selection of runway 11L for the Boeing 737 take-off occurred due to the route of exit of that aircraft that would follow to the northern sector of the Brasilia Terminal.

After the FAB 2345 landing, the TWR-BR authorized the PR-GTN to line up and maintain threshold 11L and, about one minute and fifteen seconds later, the same controller (TWR-BR) authorized its takeoff.

The PR-GTN crew began the take-off run, and almost at the same time the Boeing reached the speed of rotation, its landing light illuminated the FAB C-95M, which was still on the runway.

Then, the PR-GTN commander advanced the power levers for the maximum thrust and immediately started the rotation, managing to take off his aircraft above the one on the runway, thus avoiding a collision.

After avoiding the accident, still in the frequency of TWR-BR, the PR-GTN crew reported to that traffic control the scenario that they had just confronted.

In order to contextualize the scenario in which the incident occurred, some latent conditions present at the time of the serious incident will be presented, which will be explored in the analysis of this report:

1st Latent Condition: the Brasilia Aerodrome had several "blind spots", in which the view of the controllers, from the Control Tower, was impeded by obstacles. One of these blind spots was the stretch of TWY "H" (Hotel), between TWY "G" (Golf) and TWY "N" (November), where a grove made it impossible to see smaller aircraft from the angle of the Tower. (Figures 3 and 4).

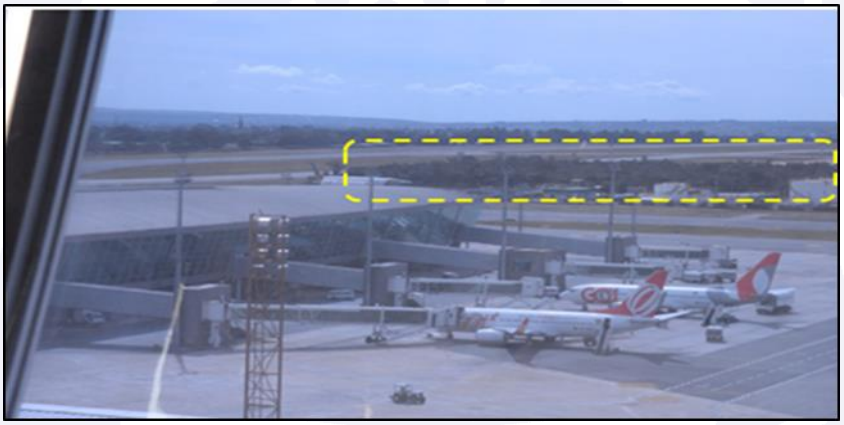

Figure 3 - Detail of the trees blocking the view of part of TWY "H". Aimed at TWR position.

Figure 4 - Blind spot region in TWY "H" due to trees in the TWR line of sight.

2nd Latent Condition: the reflectors used for the illumination of aprons in the positions known as North Pier and South Pier were in the TWR controllers line of sight and there was no device that would allow the reduction of glare, due to the light beam produced by the lamps in the night period.

Figure 5 shows the view of a section of the runway, from an angle similar to that of Figure 3, but in a photograph taken at night, demonstrating the influence of the North Pier illumination on the North Tower controller's view.

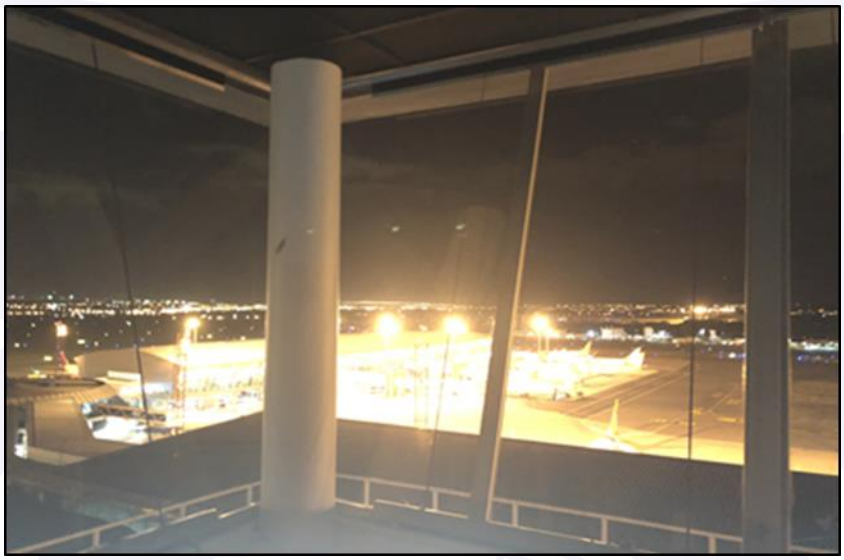

Figure 5 - Influence of the lighting of the North Pier apron in the view of the TWR.

3rd Latent Condition: The FAB aircraft had a camouflaged painting that was difficult to see at night.

4th Latent Condition: The FAB aircraft had no stroboscopic light, with only red beacon lights.

5th Latent Condition: The runway slope did not allow an aligned aircraft on threshold 11L to view a small aircraft on the runway, if the latter was in a position close to TWY "F" (Foxtrot).

6th Latent Condition: The phraseology used by the TWR-BR controllers did not condition the frequency change for the Ground Control to the release of the runway by aircraft landing on SBBR.

7th Latent Condition: The first two intersections from threshold 11L had very similar spelling designations, which could be confused visually, depending on the viewing conditions, namely "C" and "G".

Figure 6 represents the visualization of respective vertical signs in two aspect ratios to illustrate the visual perception of two different distances and how much these designations could be confused.

Figure 6 - Vertical signaling of the "G" and "C" taxiways represented in different sizes, simulating a variation of the viewing distance.

1.19 Additional information.

The Investigation Team observed that the Brasilia Aerodrome had other blind spots from the Control Tower sight. These blind spots can be identified in the yellow markings of Figure 7.

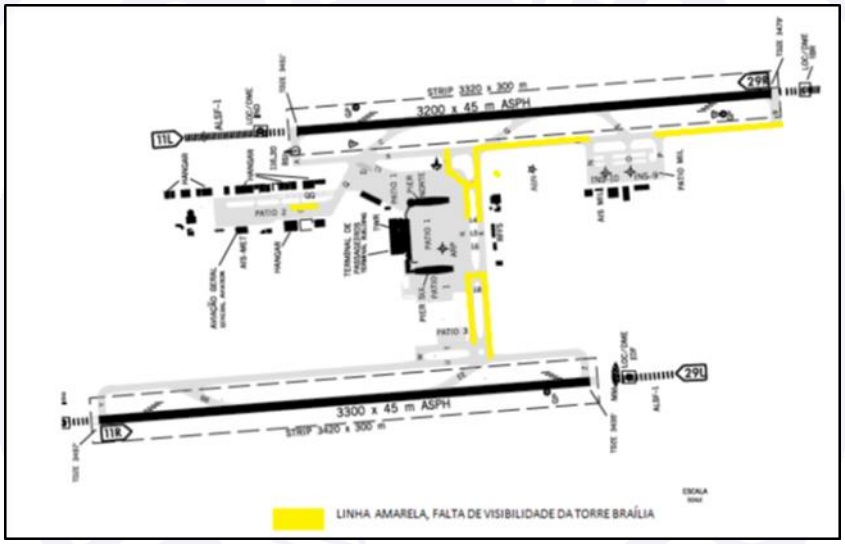

Figure 7 - Identification of blind spots of SBBR from the TWR-BR sight.

For some of these blind spots, the aerodrome operator had provided video cameras that would allow viewing of these "shadow areas" by video monitoring.

However, these cameras used by the Tower controllers were not dedicated exclusively to the use of the DECEA, with the exception of two fixed ones.

In other words, the Tower controllers did not have full control of that monitoring system. In addition, the two fixed cameras dedicated to the controllers did not totally cover the blind spots of the aerodrome.

Despite the problems arising from the difficulty in visualizing some portions of the controlled area of the aerodrome, there was not at this airport a Surface Movement Radar (SRM) that could allow the controller to use the information of this system for the purposes described in item 4.1 of the AIC A12/03 (Employment of Surface Movement Radar), as follows:

"4 OPERATIONAL PROCEDURES (our emphasis)

4.1 The air traffic controller shall use the SMR information to:

a) confirm that the runway in use is clear of aircraft, vehicles or obstructions prior to takeoff or landing;

b) ensure that the departing aircraft is already lined up on the correct runway;

c) ensure that the aircraft that landed has already cleared the runway;

d) make sure that the aircraft that is taking off has already started the run for takeoff;

e) provide directional information to pilots or vehicle operators on request, provided that such information is not to be issued in the form of heading or directions instructions;

f) monitor the operation of aircraft and vehicles **in the maneuvering area in relation to the instructions issued;**

g) monitor the maneuvering area and identify the most favorable taxi routes to reduce jam and help to accelerate the flow of traffic during periods of reduced visibility or at night;

h) confirm the position information of pilots or vehicle operators;

(i) provide guidance information for emergency vehicles, as necessary;

j) assist in the timing of landing authorizations and take-offs in conditions of reduced visibility to maximize the use of the runway in use;

k) provide detection and guidance information for aircraft pilots who are unsure of their position;

l) assist in the detection of incursions on the runway in use;

m) ensure that the push-back maneuver does not conflict with other traffic in the maneuvering area;

n) provide information on the essential local traffic in or near the maneuvering area; and

o) provide information to assist aircraft avoiding prohibited sectors in the aerodrome maneuvers area."

Still on the blind spots of SBBR, there was no indication in the respective Aerodrome Chart (ADC) informing about the existence of this condition, in order to alert the pilots (hot spot), increasing the situational awareness.

In Aerodrome Charts, it is possible to indicate hot spots to signal a place in the movement area with a history of incidents or that present a potential risk of collision or runway incursion. Therefore, in this type of place, a greater attention is needed on the part of the pilots and drivers who travel in the area of movement.

During the investigation, several documents were researched, among them, the ICA 100-37/2017 (Air Traffic Services), which in its item 6.7.1.5.2 dealt with "Uncertainty about position in the area of maneuver ", as shown below:

"6.7.1.5.2 **In situations where a pilot is in doubt as to the position of his aircraft in relation to the maneuvering area** but acknowledges that the aircraft is on a runway, the pilot shall immediately:" (emphasis added)

(a) notify the competent ATS body about the circumstances (including the last known position);

(b) clear the runway as soon as possible, if it is able to locate an appropriate nearby taxiway, unless otherwise directed by the ATS body; and

c) stop the aircraft. "

Also in ICA 100-37/2017, item 6.14.6.4 dealing with "Landing and post-landing maneuvers" contained the following text:

> "6.14.6.4 **When necessary or desirable**, for example, due to low visibility conditions, **an aircraft landing** or taxiing **may be instructed to inform when the runway has been unoccupied**. The report shall be made when the entire aircraft is beyond the waiting position of the runway in use." (our emphasis).

In the same documentation (ICA 100-37/2017), item 6.13.2.1 dealt with the "Separation of departing aircraft", as follows:

> "6.13.2.1 To an aircraft that is leaving, normally, it will not be allowed to start the take-off until the preceding aircraft has crossed the end of the runway in use, or has started a turn, or until all aircraft that have previously landed and those that are about to leave **are out of the runway in use.**" (emphasis added).

In turn, the MCA 100-16/2016 (Air Traffic Phraseology) included the following standard sentence phraseology in the table of examples of item 3.4.3.4 (After Landing Instruction):

> "TAM 3320, on the Ground at 02, (...), **when clearing the runway** call Ground Control 121.9" (our emphasis).

The ICA 63-21/2015 (ATS Runway Incursion Occurrence Prevention Program), which in its section 4.2.6 dealt with "Runway View", contained the following text:

> "4.2.6. RUNWAY VIEW
>
> 4.2.6.1. In general, it has been found that **some aerodrome control tower controllers look at aircraft when issuing authorizations without visually scanning the runway before issuing the take-off and landing permits**, believing that the runway is clear because of not having previously issued an authorization for an aircraft or vehicle to enter the runway. However, there are records of incidents caused by the presence of unauthorized vehicle or aircraft on the runway in use. (our emphasis).
>
> 4.2.6.2. Therefore, in order to avoid recurrence of this type of incident, **controllers must be trained in the need to observe the runways to ensure that it is clear of obstacles before authorizing cross-over, landing, take-off or positioning."** (our emphasis).

The Investigation Team, which had DECEA advisers in its constitution, did not identify any regulations that clearly specified the time when pilots should change the frequency from the Tower to the Ground Control after landing.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

Analyzing the latent conditions present in this event, it was possible to see how the alignment of several small fragilities, together with some active flaws, established a scenario that culminated in the occurrence of this serious incident that practically contained all the necessary elements for the outcome of an accident of large proportions.

In order to contextualize the analysis of the main factors present in this event, we will present the various existing conditions, observed in light of the perspectives of those involved, beginning with the context experienced by the FAB 2345 pilots.

During the approach and landing briefing by the FAB aircraft commander, while still on a cruise flight, he stated that after the touchdown, he would control the deceleration of the aircraft, in order to clear the main runway through TWY "F" (Foxtrot).

This decision was based on the arguments that TWY "F", by virtue of its angulation in relation to the direction of landing, would be a quick exit intersection (for landings on runway 11L) and also because that taxiway would allow a more direct access to the Brasilia military apron.

Considering the landing performance of the military aircraft and the runway length from the touch zone (from threshold 11L) to TWY "F", the pilot could plan a fairly smooth deceleration as it would have a great distance to degrade the speed which was not very high (low performance aircraft).

However, it was found that during the landing, the pilot used the reverse and brake controls at an intensity higher than that, which would be required for the aircraft to be at a controlled speed in a position close to TWY "F".

After controlling the aircraft, in an earlier position than previously planned, the pilot tried to identify, by reading the vertical signs of the aerodrome, what would be the new intersection that he would use to clear the runway.

However, when he glanced quickly at the identification plate of the intersection he would be able to use, he confused the letter "G" with the letter "C" and therefore asked the copilot to request TWR-BR the authorization to clear the runway by the intersection that he believed to be TWY "C" (Charlie).

It should be noted that this type of distorted perception is plausible, considering the similarity of the letters and the conditions of visualization, which, in this case, were aggravated by the fact that it was a night period.

In this case, in theory, the pilot would not have failed to comply with item 6.7.1.5.2 of the ICA 100-37/2017, which dealt with the procedures to be adopted for situations of "Uncertainty about position in the maneuvering area", because when he saw (even if incorrectly) the vertical signaling for the taxiway that he wished to enter, there was no uncertainty in his judgment.

Some conditions may have contributed to the copilot not responding to the commander's misguided request, such as her lack of familiarity with the aerodrome, the actual existence of a TWY "C" (Charlie) connected to that runway and her attention which was aimed at performing the after-landing check, rather than assisting in following the aircraft roll.

It was not possible to clarify whether the SBBR ADC chart consultation was fully explored at the time of the approach and landing briefing performed by the FAB 2345 pilot, as well as its use during the taxi. In this context, the lack of real-time monitoring of this chart by the copilot, may have contributed to the incorrect perception of the aircraft position on the ground after landing.

Allied to these conditions, it is possible that the little familiarity of the copilot with the operation in SBBR at night has contributed for her to exert little interference on the actions of the pilot.

Thus, the copilot followed strictly what was requested by the commander and questioned the Tower about the possibility of clearing the runway by TWY "C" (Charlie).

In turn, the Tower controller was not expecting to receive any message from the aircraft that had just landed, because at controlled aerodromes, normally the first post-landing message is sent by the Tower rather than by the aircraft.

In addition, in the controller’s perception, the copilot had sent the message (of a request to clear on the TWY "C") with a rapid pace of speech, which made it impossible to understand the information.

Despite not being able to understand the content of the message sent by the military aircraft’s copilot, the controller did not request that the crew repeat the phraseology, because it inferred that the pilots should only be informing that the aircraft was controlled.

The correct attitude in this situation would be a Tower controller request to have the message repeated by the crew, in order to avoid communication conflicts.

In the real context, the controller disregarded the crew message, which was erroneously requesting to clear the runway through TWY "C" (Charlie) and simply sent the standard message it would already use, even if it had not been surprised by the initial call of the aircraft on the ground.

When verbalizing: "Pioneer 45, clear on the Golf and call Ground on frequency 121.8.", the controller experienced the following context:

- visualized a fully controlled aircraft, having a compatible speed to immediately clear the runway;

- inferred that the aircraft had reported that it was already controlled;

- the exit intersection next to that already controlled aircraft was TWY "G" (Golf);

- had observed the trajectory of the aircraft, moving to enter in TWY "G" (Golf); and

- after his post-landing instruction, there was the correctly read back by the crew, reporting that they would clear the runway by the TWY "G" (Golf).

However, from the crew's perspective, the message conveyed by the controller represented a totally different context.

In fact, the aircraft was controlled and the crew would clear the runway through TWY "G" (Golf), as the controller could observe from the Tower.

However, mistakenly believing that TWY "G" (Golf) was TWY "C" (Charlie), upon hearing the controller's "Clear on the Golf" message, after the request to clear on Charlie, the crew interpreted the phraseology as negative to their request, which may have sounded like: do not clear on TWY "C" (Charlie), but on TWY "G" (Golf).

Considering that TWY "G" (Golf) was located on the next exit on the right, after TWY "C" (in the direction of aircraft landing), the pilots interpreted that they should clear the runway by the next exit on the right and not by the one which was already in its side.

Soon, in fact, the crew stopped joining TWY "G" (Golf) and headed towards TWY "F" (Foxtrot).

Another communication problem occurred due to the same message sent by the Tower, but referring to the moment of the frequency change for the Ground Control.

From the point of view of the Tower controller, as the aircraft was already on the verge of clearing the runway by the TWY "G" (Golf), the pilots could already listen to the Ground Control.

Thus, using the additive conjunction "and" in the phrase "clear on the Golf and call Ground at frequency 121.8", the controller was inferring that the aircraft was already clearing the runway in use, and consequently, could change the frequency as soon as passing the stop bar of the intersection in question.

In this context, the Tower controller did not use the standard phraseology prevised in item 3.4.3.4 of the MCA 100-16/2016 Phraseology, which presented in its model an example of instruction after landing, conditioning the frequency change at the exit of the aircraft from the runway in use, as already presented in section 1.19 (Additional information) of this Final Report.

Nevertheless, from the perspective of the FAB aircraft pilots, upon receiving the determination of the Tower controller to clear on the Golf and call Ground Control on the 121.8MHz frequency, they may have internalized that, from that moment, they would be

authorized to perform the two actions (clear the runway and change the frequency to call the Ground Control) without one being necessarily conditioned to the other.

However, because of the aforementioned FAB 2345 crew's misunderstanding regarding TWY positioning, the additive conjunction used in the controller's message, rather than a conditional one, may have contributed to the copilot carrying out the frequency change for the Ground Control with the aircraft still occupying the main runway.

By switching the frequency to the Ground Control, still occupying the main runway, the military aircraft stopped listening to the Boeing 737's flight, controller's authorization to take off, and thus were unable to interfere with that inadequate clearance given by the Tower.

Such a situation would not occur if the controller had conditioned the call at the new frequency to clear the main runway, using phraseologies such as: "When cleared on Golf, call Ground on frequency 121.8"; or, "After clearing on Golf, call Ground on frequency 121.8"; or "When you clear on Golf, call the Ground on frequency 121.8".

From this moment on, it is necessary to go back a bit in the chronology of the event, in order to understand the factors that contributed (or may have contributed) to the failure of the Tower controller when authorizing the takeoff of an aircraft, with the runway still occupied by other traffic.

There was that moment in which the controller visualized the FAB controlled aircraft, after the landing, next to TWY "G" (Golf) and therefore sent the message so that the crew cleared the runway by that intersection, even without having understood that the crew had requested to clear on TWY "C" (Charlie).

However, when the controller received the correct read back of the instruction, even though it was sent in a synthesized manner by the military crew, he temporarily stopped focusing his attention to C-95M, considering that his orientation (which was "repeated" by the FAB's copilot) would be strictly enforced.

It turns out that the Tower controllers were already accustomed to working with a marginal operating scenario, where a grove on the side of TWY "H" (Hotel) prevented the visualization of a controlled stretch of this taxiway as already shown in Figures 3 and 4.

When attempting to see the FAB 2345 near TWY "G" (Golf) and not see it, the controller immediately inferred that the aircraft should be hidden in the blind spot of TWY "H" (Hotel), since it would be moving to the military apron.

Therefore, in the context experienced by the controller, not having seen the aircraft on the taxiway meant that plane should be hidden behind the grove, not that the aircraft could still be on the main runway.

However, according to the Tower controller himself, even believing that the aircraft was already in TWY "H" (Hotel), he made a visual check of the main runway before authorizing the PR-GTN for takeoff, since according to item 6.13 .2.1 of ICA 100-37/2017, take-off could only be authorized with the runway totally clear.

In this context, some factors may have contributed to the fact that the controller had not sighted the C-95M, considering the hypothesis that a visual scan was actually performed on the main runway prior to the commercial aircraft takeoff.

The first factor is related to a psychological aspect called expectation, which occurs when an individual projects in a given situation what he or she really expected to encounter at first.

Therefore, the controller may have been encouraged to believe that the runway was clear since it was expected that the FAB aircraft would have left the site, thus leading to its non-sighting, due to the TWY "H" (Hotel) blind spot.

Other aspects that may have influenced the controller's non-visualization of the aircraft are related to the illumination of the North Pier apron and to the characteristics of the FAB aircraft at night.

The Investigation Team identified that the working conditions of the Brasilia Tower controllers, at night, occurred under heavy negative interference caused by the glare from the lighting of the aprons.

The spotlights used in the aprons did not have a direction mechanism that allowed the illumination of the ground without interfering in the line of sight of the Tower controllers.

Thus, under these conditions, the identification of some aircraft, especially small aircraft, was greatly impaired, due to the glare produced by the spotlight bulbs, as shown in Figure 5.

Associated with this condition, the aircraft involved in the incident in question was a FAB aircraft, which in addition to being small, still had a camouflaged painting and did not have stroboscopic lights, having only red beacon lights.

In this environment, with all the latent conditions presented, the identification of that aircraft was indeed difficult for the controller.

However, in view of the various interferences that made it difficult for the controllers of the SBBR Tower to view the area, it could be used more frequently the facility provided in item 6.14.6.4 of ICA 100-37/2017, which provided that an aircraft landing could be instructed to inform them when clearing the runway in use.

In this way, the aircraft themselves would provide the runway clear information.

To trigger the analysis of the event, now from the viewpoint of the Ground controller, it is necessary to go back to the moment when the crew of the FAB 2345 made the initial call on the frequency 121.8 MHz, sending the following message:

> "Brasilia Ground, good evening! Pioneer 45 landed on 11L. **It will clear on the "Golf"** to the military apron."(our emphasis).

Although the crew used the verb tense in the future, when they said they would clear the runway through TWY "G" (Golf), the Ground Controller probably did not realize that the message implied in essence the information that the aircraft would still be on the runway in use.

Otherwise, if the aircraft was already off the runway, the verbal time employed by the crew would be in the past with a message containing something like: "... cleared on "Golf"...".

Therefore, it is possible to establish the hypothesis that the Ground Controller probably did not visually follow the C-95M movement after the initial call made on his frequency, because if he had done so, he would have realized that, at the moment the pilots reported they would clear the runway through the TWY "G" (Golf), the aircraft had already passed through that intersection.

It is inferred that, at the moment the initial call was made in the Ground Control frequency, the FAB aircraft was already in the process of displacing to TWY "F" (Foxtrot), since there was a lapse of about twenty seconds from the Tower's message (00h30min33s UTC) until that first contact with the Ground Control (00h30min53s UTC).

Considering that the crew of FAB 2345 believed that TWY "G" was the next to its right, in theory, any trajectory of that military aircraft, from that moment on, he would already be characterized as a displacement for TWY "F" (Foxtrot).

Therefore, if the Ground controller had noticed that the aircraft had already passed the TWY "G", would be able to rectify the message sent by the military crew and warn the Tower

controller about the presence of the aircraft on the runway and with these actions, perhaps even avoiding the incident.

It should be noted that the interferences related to the work environment, experienced by the Ground Controller, were the same as those of the Tower controller, since both operated from the same tower.

It was inferred that there was not an adequate coordination of the passage of the FAB 2345 control from the Tower to the Ground, after the respective landing. If this coordination was effective, when the Tower controller informed the GND-BR that it would be transferring the aircraft entering the TWY "G" (Golf), the Ground Control would be trying to locate the aircraft in that position and would not find it.

In turn, the scenario experienced by the PR-GTN crew involved in the occurrence also contained some influencing conditions for the serious incident.

The first of them was the receipt of the takeoff authorization from the Tower controller, because in aviation, there is the common understanding that a controller would only authorize a takeoff with the runway totally cleared.

Even so, the authorization of a controller does not inhibit the commander's responsibility to ensure the safety of the flight.

Therefore, if in this case the presence of the FAB aircraft still in the runway was noticed, the pilot should not takeoff, in spite of the instruction of the controller authorizing the take-off.

However, because of the runway slope, it would not be possible for a crew to see a small aircraft at a position close to the intersection of TWY "F" (Foxtrot), with its aircraft lined up over threshold 11L, as was the case.

That way, when authorized for takeoff, the PR-GTN pilots did not spot any obstacles that could prevent the start of their run.

During the take-off run, after passing the runway slope, the FAB 2345 early viewing by the PR-GTN crew may have been hampered by the following factors:

- the lack of stroboscopic lights on the military aircraft may have reduced the possibility to notice the presence of this aircraft on the runway;

- the aircraft camouflaged painting may have attenuated the visual contrast, hindering its sighting; and

- the red lights of the FAB 2345 collision system could easily be mistaken for the red signal lights at the end of the runway in use.

Therefore, the combination of all these conditions may have contributed to the sighting to occur only at the time when the 737 headlights fully lit the military aircraft.

In this scenario, where the traffic conflict visualization occurred in marginal conditions, the dexterity of the PR-GTN crew was essential to avoid collision and thus prevent a catastrophe.

In view of the above facts, it is possible to understand that the context of the work place, considering SBBR conditions, both for the controller and for the military and civil aircraft crew, presented physical characteristics that compromised a safe operational performance, mainly at night.

3. CONCLUSIONS.

3.1 Facts.

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

b) the military pilots had valid health inspections;

c) the civil pilots had valid B739 type aircraft (which included model 737-8EH) and IFRA Ratings;

d) the military pilots had valid CVI.

e) all pilots were qualified and had experience in those types of flight;

f) the civil aircraft had valid Airworthiness Certificate (CA);

g) both aircraft were within the limits of weight and balance;

h) both aircraft had their respective technical maintenance records updated;

i) the weather conditions were favorable for the visual flight;

j) there were several blind spots in sight area, both in the Tower control position and in the Ground Control position;

k) some blind spots were monitored by video cameras;

l) a set of trees prevented the visualization of a section of the TWY "H" (Hotel), between the TWY "G" (Golf) and the TWY "N" (November);

m) the section hidden by the trees was not covered by the cameras monitoring system;

n) headlights used to illuminate the aprons obfuscated the TWR-BR controllers' vision at night;

o) the FAB C-95M did not have stroboscopic lights;

p) the Tower authorized the alignment of the civil aircraft at threshold 11L, after the touchdown of the military aircraft on the same runway;

q) after landing, the military crew requested the Tower to clear the runway by theTWY "C" (Charlie);

r) the Tower instructed that the military aircraft should clear the runway by the TWY "G" (Golf) and call Ground on frequency 121.8 MHz;

s) the military crew continued the taxi on the runway in use towards the TWY "F" (Foxtrot);

t) the military crew switched the frequency to the Ground Control while taxiing on the runway in use;

u) the military crew contacted the Ground Control, informing that it would clear the runway in use by the TWY "G" (Golf);

v) the military crew corrected the message sent to the Ground Control, requesting to clear the runway by the TWY "F" (Foxtrot);

w) the Tower authorized the take-off of the PR-GTN while the FAB 2345 still occupied the runway in use;

x) the civil aircraft passed over the military aircraft on a stretch of the runway in use near the TWY "F" (Foxtrot);

y) there was no damage to the aircraft; and

z) all of them left unharmed.

3.2 Contributing factors.

- **Attention – a contributor.**

The attention of the Tower controller was hampered by the context in his work routine in which, due to physical obstacles, expectations were created that the aircraft would follow the instructions sent, even if they could not visually accompany them from their position, as happened in this case.

The fact that the Tower controller did not identify that the FAB, after having read back that it would clear by the TWY "G", did not do so, demonstrated that his focus of attention was not properly oriented to the situation.

In addition, the Ground controller did not identify that the aircraft, when at the first contact in his frequency, remained on the runway in use.

- **Attitude – undetermined.**

Despite the good technical preparation, the FAB 2345 copilot still showed little familiarity with the SBBR operation at night. This may have contributed to the fact that she did not contest the instructions received from the commander regarding the taxi sequence after landing on runway 11L, as regards the selection of the TWY to clear the runway in use.

Likewise, the attitude of not following the standard phraseology prescribed in the MCA 100-16/2016, by the Tower controller, may have contributed to the FAB 2345 crew carrying out the frequency change for the Ground Control, before its exit from the runway in use.

- **Communication – a contributor.**

Even not comprehending the request of the FAB 2345 crew after landing, the Tower controller did not urge them to repeat the message and issued instructions for the aircraft to clear the runway on TWY "G" (Golf), considering the proximity that the aircraft was from that intersection.

In this case, there was a selective listening, in which the spoken content was deduced from what was expected to be heard in that type of situation.

The message received by the FAB crew to "clear on Golf" may have been mistaken for a denial of the TWY "C" (Charlie) request.

Furthermore, the non-assimilation by the Ground controller of the verbal (future) time used by the crew of the FAB aircraft, by communicating the intersection where they would clear, contributed to the fact that he did not realize the aircraft was on the runway in use.

- **Physical work-conditions – a contributor.**

The light interference from the North Pier apron and the TWY "H" blind spot (Hotel) constituted physical characteristics of the Tower's workplace that compromised the safe operating performance considering the nighttime operation.

- Air Traffic Coordination (ATS) – a contributor.

The inadequate exchange of information between the Tower controller and the Ground Control in relation to the Air Force aircraft after its landing has contributed to the uncertainty as to the actual positioning of that traffic.

- Employment of ATS means – undetermined.

Despite all difficulties identified for the visualization of the C-95M on the runway, the Tower controller did not use the resource prevised at ICA 100-37/2017, which provided an instruction for the aircraft itself to report when it had cleared the runway in use. It is possible that the employment of this means could prevent the incident.

- **Use of phraseology by ATS – undetermined.**

It is possible that the phraseology used by the Tower controller, when he instructed the crew of the FAB 2345 to call the Ground Control, without conditioning this act to the exit of

the aircraft of the runway in use, has induced the pilots to make the exchange of frequency being still on the respective runway.

With this action, the military pilots were unable to interfere when the Tower improperly authorized the 737 takeoff while the runway was still occupied.

- ATS Control Ability – a contributor.

There was no ability in performing ATS procedures, such as visual scanning and phraseology usage that exhausted the possibilities of identifying an aircraft on the runway at the time of the PR-GTN takeoff.

- **Airport infrastructure – a contributor.**

The existence of several blind spots at the aerodrome contributed to the Tower controller inferring that the FAB 2345 was in a position different from its real location after landing.

The cameras used to mitigate the risk of blind spots did not cover all areas and were not dedicated exclusively to the use of the TWR-BR.

The lighting of some aprons obfuscated the view of the TWR-BR controllers, damaging the sighting of the aircraft, especially small ones.

All these conditions, combined with the absence of a RADAR Surface Movement System, contributed to the military aircraft not being noticed on the runway in use at the time of the PR-GTN take-off was authorized.

- **Clearance limit – a contributor.**

Involuntarily, the crew of the FAB 2345 did not comply with the Tower instruction to clear the runway by the TWY "G" (Golf).

The remaining on the runway in use by the military aircraft, in spite of a different instruction from the controller, contributed to the incident.

- **Perception – a contributor.**

The similarity between the letters "C" and "G" associated with the conditions for their visualization at the night period contributed to the pilot's misperception.

The controller's perception was reduced by his expectation that the crew would strictly follow the guidance.

In addition, the failure to view the aircraft due to the TWY "H" (Hotel) blind spot led him to conclude that the runway was clear for another operation.

The expectation of not finding the aircraft in the runway in use reduced the controller's perception of the real location of that airplane, contributing to the ending of this occurrence.

- **Insufficient pilot’s experience – undetermined.**

The lack of familiarity of the FAB 2345 copilot with the aerodrome may have contributed for her not questioning the commander's message, requesting to clear the runway for the TWY "C" (Charlie) when, in fact, the intersection they passed by was the TWY "G" (Golf).

It is possible that the little experience of that copilot had induced her to faithfully follow the commander's guidance.

- **Support systems – undetermined.**

No regulation was identified that explicitly defined the position in which the aircraft should perform the frequency change for the Ground Control after landing.

The lack of prediction in standards may have contributed to the FAB 2345 crew keeping the Ground Control frequency while occupying the runway in use.

4. SAFETY RECOMMENDATION.

A proposal of an accident investigation authority based on information derived from an investigation, made with the intention of preventing accidents or incidents and which in no case has the purpose of creating a presumption of blame or liability for an accident or incident. In addition to safety recommendations arising from accident and incident investigations, safety recommendations may result from diverse sources, including safety studies.

In consonance with the Law n°7565/1986, recommendations are made solely for the benefit of the air activity operational safety, and shall be treated as established in the NSCA 3-13 "Protocols for the Investigation of Civil Aviation Aeronautical Occurrences conducted by the Brazilian State".

Recommendations issued at the publication of this report:

To the Brazil's National Civil Aviation Agency (ANAC):

IG-065/CENIPA/2018 - 01 Issued on 12/18/2019

Act together with INFRAMERICA, in order to make that Aerodrome Operator to adopt measures in relation to the lighting structure of the aprons (North Pier and South Pier), in order to avoid that the light coming from the respective spotlights interferes negatively in the line of sight of the TWR-BR controllers.

IG-065/CENIPA/2018 - 02 Issued on 12/18/2019

Work together with INFRAMERICA and DECEA, so that DTCEA-BR exclusive cameras are installed in the Brasilia International Aerodrome, in order to guarantee the visualization and control of all blind spots of that aerodrome.

IG-065/CENIPA/2018 - 03 Issued on 12/18/2019

Work together with INFRAMERICA and DECEA, in order to evaluate the relevance of modifying one or both of the letters of the "C" (Charlie) and "G" (Golf) Taxiways of the Brasilia International Aerodrome, so that to avoid confusion or misunderstanding on the part of the crews operating at that aerodrome.

IG-065/CENIPA/2018 - 04 Issued on 12/18/2019

Work together with INFRAMERICA and DECEA, in order to evaluate the pertinence of the inclusion of hot spots in the SBBR Aerodrome Charter, in order to alert the pilots operating in that aerodrome regarding the existence of blind spots in the maneuvering area.

To the Air Space Control Department (DECEA):

IG-065/CENIPA/2018 - 05 Issued on 12/18/2019

Analyze the pertinence of establishing, with clarity and in standard, the moment or position in which, after landing, the crew of an aircraft should change the frequency from the Control Tower to the Ground Control.

IG-065/CENIPA/2018 - 06 **Issued on 12/18/2019**

Alert the Brazilian air traffic controllers about the importance of using the standard phraseology prevised in the MCA 100-16, notably in what refers to item 3.4.3.4 (Instructions after landing), where an example of correct message is presented.

IG-065/CENIPA/2018 - 07 **Issued on 12/18/2019**

Alert the Brazilian air traffic controllers about the importance of using the phraseology feature provided in item 6.14.6.4 of ICA 100-37/2017, which guides that, when necessary or desirable, the controller may instruct a crew to report the moment in which its respective aircraft has cleared the runway in use.

IG-065/CENIPA/2018 - 08 **Issued on 12/18/2019**

Analyze the pertinence of establishing an Operational Model that clearly defines the procedures to be adopted by the air traffic controllers of the different positions of the Brasília International Aerodrome Control Tower in relation to the coordination of traffic when they are passing through the blind spots of the aerodrome.

IG-065/CENIPA/2018 - 09 **Issued on 12/18/2019**

Evaluate the viability of the implementation of a Surface Movement Radar (SBR) in SBBR, in order to mitigate the risks of runway incursion, due to the various blind spots in the aerodrome.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

Within the scope of the Aeronautics Command, all air operators were instructed to include in their Operational Manuals a text stating that, after landing, crews may only perform the Tower frequency change for the Ground Control after clearing the runway in use.

The Ala 1 started the negotiations with the competent environmental agencies, with the aim of enabling the suppression of vegetation that prevented the visualization of the stretch of the TWY "H" (Hotel) between TWY "G" (Golf) and TWY "N" "(November).

On December 18th, 2019.