COMANDO DA AERONÁUTICA

CENTRO DE INVESTIGAÇÃO E PREVENÇÃO DE ACIDENTES AERONÁUTICOS

FINAL REPORT
IG - 532/CENIPA/2015

OCCURRENCE:	**SERIOUS INCIDENT**
AIRCRAFT:	**PR-NHC**
MODEL:	**L410UVP-E20**
DATE:	**15 JULY 2011**

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 item 3.1, 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 15 July 2011 serious incident with the L410UVP-E20 aircraft, registration PR-NHC. The serious incident was classified as system/component failure.

After taking off, the aircraft sustained a single engine condition, and made an emergency landing on runway 33 of SBCT.

The aircraft was not damaged.

None of the aircraft occupants was injured.

An accredited representative from the Czech Republic AAII (Air Accident Investigation Institute - UZPLN) was designated for participation in the investigation.

CONTENTS

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS 5

1. FACTUAL INFORMATION. 6
1.1 History of the flight. 6
1.2 Injuries to persons. 6
1.3 Damage to the aircraft. 6
1.4 Other damage. 6
1.5 Personnel information. 6
1.5.1 Crew's flight experience. 6
1.5.2 Professional formation. 6
1.5.3 Category of licenses and validity of certificates. 7
1.5.4 Qualification and flight experience. 7
1.5.5 Validity of medical certificate. 7
1.6 Aircraft information. 7
1.7 Meteorological information. 7
1.8 Aids to navigation. 7
1.9 Communications. 7
1.10 Aerodrome information. 7
1.11 Flight recorders. 7
1.12 Wreckage and impact information. 7
1.13 Medical and pathological information. 8
1.13.1 Medical aspects. 8
1.13.2 Ergonomic information. 8
1.13.3 Psychological aspects. 8
1.14 Fire. 8
1.15 Survival aspects. 8
1.16 Tests and research. 8
1.17 Organizational and management information. 10
1.18 Operational information. 11
1.19 Additional information. 12
1.20 Useful or effective investigation techniques. 13

2. ANALYSIS. 13

3. CONCLUSIONS. 14
3.1 Facts. 14
3.2 Contributing factors. 14

4. SAFETY RECOMMENDATION. 15

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN. 16

GLOSSARY OF TECHNICAL TERMS AND ABBREVIATIONS

AFM	Aircraft Flight Manual
ANAC	Brazil's National Civil Aviation Agency
ATS	Air Traffic Services
CBA	Brazilian Code of Aeronautics
CCF	Aeronautical Medical Certificate
CENIPA	Aeronautical Accident Investigation and Prevention Center
CHT	Technical Qualification Certificate
DCTA	Aerospace Technology and Science Department
ESO	Operational Safety Event
FCU	Fuel Control Unit
FDR	Flight Data Recorder
IFR	Instrument Flight Rules
INFRAERO	Brazilian Airports Infrastructure Enterprise
Lat	Latitude
Long	Longitude
MGSO	Manual on Operational Safety Management
MLTE	Airplane, Multi-Engine, Land – AMEL
PCM	Commercial Pilot – Airplane category
PLA	Airline Transport Pilot – Airplane category
PPR	Private Pilot – Airplane category
PRE	Plan of Response to Emergency
RBAC	Brazilian Civil Aviation Regulation
RBHA	Brazilian Aeronautical Homologation Regulation
RS	Safety Recommendation
SBCD	ICAO location designator – *Caçador* Aerodrome
SBCT	ICAO location designator – *Curitiba* Aerodrome
SERIPA	Regional Aeronautical Accident Investigation and Prevention Service
SGSO	Operational Safety Management System
SIPAER	Aeronautical Accident Investigation and Prevention System
TWR	Control Tower
UTC	Universal Time Coordinated
VFR	Visual Flight Rules

1. FACTUAL INFORMATION.

Aircraft	**Model:** L410UVP-E20 **Registration:** PR-NHC **Manufacturer:** *Let Aircraft Industries*	**Operator:** NHT *Linhas Aéreas*
Occurrence	**Date/time:** 15JULY2011/17:05 UTC **Location:** SBCT **Lat.** 25°31'52"S **Long.** 049°10'32"W **Municipality – State:** Curitiba – Paraná	**Type(s):** System/Component Failure.

1.1 History of the flight.

The aircraft took off from runway 33 of SBCT, destined for SBCD. Upon passing approximately 500ft AGL, the aircraft gently yawed to the right, after losing power in the right-hand side engine.

The captain took over the aircraft controls and asked the copilot to contact Curitiba Control Tower (TWR-CT) to inform that they were returning to the aerodrome.

After completion of the memory items and checklist by the pilots, the aircraft proceeded for landing on runway 33, where it landed successfully.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	2	15	-

1.3 Damage to the aircraft.

None.

1.4 Other damage.

None.

1.5 Personnel information.

1.5.1 Crew's flight experience.

Hours Flown		
	Pilot	Copilot
Total	23,604:05	524:05
Total in the last 30 days	59:00	36:00
Total in the last 24 hours	07:15	07:15
In this type of aircraft	2,472:00	167:00
In this type in the last 30 days	59:00	36:00
In this type in the last 24 hours	07:15	07:15

N.B.: Information on the hours flown provided by the pilots.

1.5.2 Professional formation.

The pilot did his Private Pilot course (airplane category) at the *Aeroclube Rio Grande do Sul* in 1965.

The copilot did his Private Pilot course (airplane category) at the AEMG-ERA of *Minas Gerais* State in 2002.

1.5.3 Category of licenses and validity of certificates.

The pilot held an ATP license (airplane category). His technical qualification certificates for L410 type-aircraft, AMEL, and IFR rating were valid.

The copilot held a Commercial Pilot license (airplane category). His technical qualification certificates for L410 type-aircraft, AMEL, and IFR rating were valid.

1.5.4 Qualification and flight experience.

The pilots had qualification and enough experience for the type of flight.

1.5.5 Validity of medical certificate.

The pilots held valid Aeronautical Medical Certificates (CCF).

1.6 Aircraft information.

The aircraft (SN072639) was manufactured by LET Aircraft Industries in 2007, being registered in the Regular Air Transport Service (TPR) category.

Its Airworthiness Certificate (CA) was valid.

The airframe, engine, and propeller logbook records were up-to-date.

The last inspection of the aircraft ("100 hours" type) was done on 8 July 2011 by the NHT workshop in Curitiba, Paraná State. The aircraft had 28 hours of flight after the inspection.

The last overhaul of the aircraft ("R1" type) was done on 18 May 2011 by the NHT workshop in Curitiba. The aircraft had 227 hours and 45 minutes of flight after the overhaul.

1.7 Meteorological information.

The prevailing weather conditions were VMC.

1.8 Aids to navigation.

Nil.

1.9 Communications.

Nil.

1.10 Aerodrome information.

SBCT was a public aerodrome under the administration of INFRAERO. It operates VFR and IFR during day- and night-time.

The runway was paved with asphalt, thresholds 15/33, measuring 2,215 meters x 45 meters, at an elevation of 2,988ft.

1.11 Flight recorders.

After the read-out of the Flight Data Recorder in the premises of the NHT *Linhas Aéreas*, it was verified that the right engine lost power (torque drop) as the aircraft was passing 400ft AGL (and climbing).

The equipment allowed identifying just the data relative to the engines.

Although the FDR data was not enough for identifying the procedures performed by the pilots before and during the emergency, this fact did not affect 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 or incapacitation could have affected the flight crew performance.

1.13.2 Ergonomic information.

Nil.

1.13.3 Psychological aspects.

Not investigated.

1.14 Fire.

No signs of aircraft fire either in flight or after the occurrence.

1.15 Survival aspects.

Nil.

1.16 Tests and research.

While investigating this serious incident, the CENIPA received a document (dated 27 July 2011) signed by GE Aviation Czech and LET Aircraft Industries, containing procedures and tests to be performed with the objective of identifying the factors that could have led to the failure of the right engine of the PR-NHC.

The document had been written after the analysis of the FDR data and of a technical report prepared by professionals of the aircraft and engine manufacturers (LET Aircraft Industires and GE Aviation Czech, respectively) who had been to *Porto Alegre*, *Rio Grande do Sul* State, after the occurrence.

In the document, the aircraft and engines manufacturers recommended three lines of action, aiming at identifying the factors that might have contributed to the failure of the right engine:

- Replacement of the FCU (FCU LUN 6590.05) of the engine, forwarding it to the GE Aviation Czech to undergo bench tests and disassembly at the FCU OEM Facility (Czech Republic), so that its operating condition could be verified;
- Confirmation of faithful compliance, on the part of the crew, with the procedures established in the Aircraft Flight Manual (AFM), with special attention to the altitude prescribed for the reduction from takeoff power to climb power, or maximum cruise power; and
- Verification of the quality of the fuel present in the PR-NHC during the occurrence of the accident.

Although the CENIPA was informed of the serious incident only on 18 July 2011, that is, three days after the occurrence, checks were carried out in the aircraft (including filters and other fuel system components), in addition to tests of the fuel at the refueling truck (in SBCT). The results of the tests ruled out the hypothesis of fuel contamination.

No evidence was found of non-compliance with the Aircraft Flight Manual (AFM) procedures by the crew of the NHT *Linhas Aéreas*.

Therefore, the commission decided to follow the recommendation made by the manufacturers, namely, send the FCU (LUN 6590.05) to the premises of the *GE Aviation Czech* so that its functionality could be verified. In the sequence, the FCU was to be disassembled at the facilities of the manufacturer in *Jihostroj Velesin* (Czech Republic).

GE Aviation Czech provided the CENIPA with a Test Program, recommending the procedures to be performed in the FCU LUN 6590.05-8 at their premises.

The tests had the objective of verifying/evaluating the FCU condition, especially in relation to the operation of the engine with water injeciton, following the prescriptions contained in the manuals of the aircraft, engines, and AFM.

During these tests, the water injection was selected to its maximum value, that is, five liters per minute (Operation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part Nº 0982404).

The Operation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part Nº 0982404 page 2-6, states that water injection into the engine is to be switched off before reducing the throttles from takeoff-power to any other power settings.

The manual explains that if such procedure is not followed, an engine flame-out may occur:

> "Take-off rating with coolant injection:
>
> This paragraph is valid only…[…] by interturbine temperature increase.
>
> Warning: If it is necessary – for any reason – to change from the take-off rating with coolant injection to any lower rating, coolant injection must be stopped prior to engine power decrease. If this warning will not be adhered to the injected coolant can cause the flame-out."

According to the Test Program sent by *GE Aviation Czech* (Praha), the evaluations would be basically carried out in the two following manners:

- *"Approved service regime according to M601E Operational Manual No 0982404."*

There would be a takeoff simulation with reduction from takeoff power to 85% Ng, with previous switch-off of the water injection. Such reductions of the engine would take place at 1-second intervals (three times) and 6-second intervals (three times).

Such tests were carried out on 3 October 2011 (FCU provided by the manufacturer) and on 4 October 2011 (FCU LUN 6590.05-8, which equipped the PR-NHC at the moment of the incident). None of the twelve tests resulted in engine failure.

- *"NOT approved service regime according to M601E Operational Manual No 0982404."*

There would be a takeoff simulation with reduction from takeoff power to 85% Ng, without previous switch-off of the water injection.

The engine reductions would take place at 1-second intervals (three times), and at 6-second intervals (three times). Before the beginning of the tests, the power lever was adjusted in order to discontinue the water injection automatically, in simulation of what would happen (in theory) in case the water injection was not manually interrupted prior to engine power reduction.

The tests were carried out on 3 Ocotober 2011 (FCU provided by the manufacturer), and on 4 October 2011 (FCU LUN 6590.05-8, which equipped the PR-NHC on the day of the incident).

The main difference in relation to the tests commented earlier was the fact that the water injection was not switched off prior to the reduction from the takeoff power regime to a lower one, in opposition to the prescriptions contained in the manual aforementioned.

On 3 October 2011, with the FCU provided by the manufacturer, an engine flameout occurred six seconds after the power setting was reduced.

During these tests, the water injection selector-switch was left in the position 3, that is, allowing an injected volume of water of about 5 liters per minute.

On 4 October, this time with the FCU involved in the incident, an engine flameout occurred 1 second after the power setting was reduced.

The result of the of the tests was that the engine flameout occurred on two occasions: one with the FCU provided by the manufacturer, and another with the FCU equipping the PR-NHC at the moment of the incident, in a total of 12 power setting reductions with water injection.

On 5 October 2011, a series of functionalilty tests of the FCU LUN 6590.05-8 was carried out in the premises of the component manufacturer in Jihostroy Velesin.

Considering that all the results were satisfactory, and that it was not possible to identify any problems that could justify the failure of the PR-NHC right-engine, a disassembly of the component was not necessary.

The technical report issued by the Department of Science and Aerospace Technology (DCTA) presented the following conclusions:

STABILITY LIMITS: for any combustion chamber there is both a *rich* limit and a *weak* limit for the air/fuel ratio in which a flameout occurs, i.e., the flame is extinguished, although the instability will frequently appear before this limit is reached.

The DCTA technical report cites the book *The Gas Turbine Theory - HIH Saravanamuttoo, GFC Rogers e H Cohen*, making it clear that "t*he range of air/fuel ratio between the rich and weak limits is reduced with increase of air velocity, and if the air mass flow is increased beyond a certain value it is impossible to initiate combustion at all*". According to the DCTA, the situation in question is aggravated with the injection of water.

During the discussions of the tests carried out in the premises of the GE Aviation Czech, the LET Aircraft Industries representative presented a document relative to two test flights in which the power levers were reduced without switch-off of the water injection, in opposition to the aircraft manual.

According to the document, there was only one engine-flameout event after various power setting reductions.

Since the LET Aircraft Industries representative did not explain the real purpose of those test flights, with procedures in opposition to the aircraft manuals, and the fact that this document was only presented to the Brazilian investigators after the differences between the aircraft manuals and the manuals utilized by the NHT Linhas Aéreas had already been identified, the investigation commission decided not to take the document into consideration.

1.17 Organizational and management information.

The investigation commission observed that the company had doubts about the notification of occurrences prescribed in the SIPAER Norms.

The company had a mistaken understanding that the ANAC would be the entity responsible for the management of the occurrence in question, believing that it was just an aircraft malfunctioning, something that was contemplated in the manuals.

As a result, the CENIPA was only notified of the incident on 18 July 2011, after some administrative assistance provided by the SERIPA 5.

The ANAC, although being informed of the occurrence on 15 July 2011, did not advise the company to fill out the Occurrence Notification and Confirmation Sheet 05C (FNCO 05C), nor to make a phone call to the CENIPA (or even to the SERIPA 5, responsible for the region).

1.18 Operational information.

The aircraft was within the weight and CG limits specified by the manufacturer.

The aircraft took off from the runway 33 in SBCT at 14:00 local time, destined for SBCD, with the copilot on the controls.

When the aircraft was passing 400ft, with the engines being throttled back to a lower power setting (as prescribed in the aircraft manual), there was failure of the right engine.

The pilots observed that the right engine changed to an *auto feather* condition. The captain then took over the aircraft controls, and mantained the aircraft on level flight at a speed of approximately 120kt.

The captain told the copilot to inform Curitiba Control Tower (TWR-CT) about the emergency and about their intention to return to the airport. TWR-CT told them that they were cleared to land on runway 33, on a wind of 330º at 15kt.

After completion of the memory items by the pilots, the captain requested reading and accomplishment/confirmation of the checklist for *engine failure after v1*, which was done up to "*pnf - inoperative engine.....parameters"*.

Taking into account that the right engine still had a residual (powerless) rotation, the crew decided not to shut it down so as to keep an electric and hydraulic energy backup.

The aircraft landed uneventfully on runway 33.

From interviews with company pilots, including the ones involved in the incident, the investigation commission observed that the procedures established in the AFM had been complied with in an adequate and safe manner.

According to the *NHT Linhas Aéreas* Standard Operation Procedures – Chapter 3 – CWD, LET 410, page 20, and to the L410 UVP-E20 Flight Manual*, section 4, normal procedures, page 49*, "*water injection is automatically stopped when the engine is throttled back to a lower power setting, that is, when the power control lever is moved back beyond the 88% Ng or 92% Ng*."

This piece of information appears (not very clearly, though) in the *Instalation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part No 0982502, page 7-19* and in the *Maintenance Manual Part No 0982055, page 507*.

Just for clarification purposes, in accordance with the *Instalation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part No 0982502, page 7-19* and with the *Maintenance Manual Part No 0982055, page 507*, the *microswitch* utilized in the *autofeathering* system is identical to the one utilized in the water injection system. Both have the same torque setting (88% Ng and 92% Ng) for working with distinct objectives. This piece of information does not appear in these manuals in a clear manner.

The NHT Linhas Aéreas *Standard Operation Procedures – Chapter 3 – CWD, LET 410*, the *L410 UVP-E20Flight Manual*, *section 4*, *normal procedures, page 49*, the *L410 UVP-E20 Flight Manual, section 7, systems of airplane, pages 57 to 64*, and the *L410 UVP-E20Flight Manual, section 5, performance, page 60b*, establish procedures and parameters, in addtion to containing items of information to be observed/followed by the company pilots when they make use of *Water Injection* during the takeoff.

None of the documents abovementioned refers to the *Operation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part Nº 0982404,* in relation to the possibility of engine flameout if water injection is not switched off after takeoff or before reduction of the engines to a lower power setting (see item 1.16).

1.19 Additional information.

The Command of Aeronautics' Systemic Norm 3-13 (NSCA 3-13) has the purpose of establishing (within the scope of the complementary aeronautical legislation addressed in the Brazilian Code of Aeronautics, Article 1, Paragraph 3) the protocols, responsibilities and duties associated with the investigation of aeronautical accidents, serious incidents and incidents conducted in the Aeronautical Accident Investigation and Prevention System – SIPAER –, the central organization of which is the Aeronautical Accident Investigation and Prevention Center – CENIPA –, aiming at the uniform compliance with the Standards and Recommended Practices (SARPs) set up by the Annex 13 to the Convention on International Civil Aviation.

The subitem 1.3 of the NSCA 3-13 is applicable, among other entities, to the National Civil Aviation Agency and to the Air Service operating organizations, including the companies of regular and non-regular public transport, air-taxi, specialized air services, aeroclubs, and flying schools.

The item 4.1 of the aforementioned Norm states that, on account of a provision contained in the Brazilian Code of Aeronautics, every person who learns of an aeronautical occurrence, or of the existence of aircraft wreckage, has the obligation of notifying it to the nearest public authority, who will then pass the information onto the CENIPA, or onto the pertinent SERIPA.

According to the item 4.4.1 of the same Norm, the authentication of an Aeronautical Occurrence is a procedure carried out exclusively by the CENIPA, with the objective of ratifying or rectifying the classification, the type of occurrence, the entity responsible for the investigation, and other information deemed necessary for the process of investigation.

The Law no. 11182 of 27 September 2005 (Article 2) states that it is competence of the Union, by means of the ANAC, and in accordance with the policies established by the Executive and Legislative Branches, to regulate and inspect the activities of civil aviation, as well as the ones associated with the aeronautical and airport infrastructures.

Still according to this Law (Article 8), the ANAC has the responsibility of adopting the measures necessary for accommodating the public interest, as well as the fomentation of the Brazilian civil aviation, aeronautical and airport infrastructures, working independently, within the legal norms, with impersonality and publicity; […] it also has the competence to regulate and inspect air services, aeronautical products and processes, professional formation and training of specialized personnel, auxiliary services, civil aviation safety, air transport facilitation, qualification of crews, emission of pollutants, aircraft noise, reservation systems, movement of passengers and cargo, and other civil aviation activities.

According to the RBAC 135 (135.21), every certificate holder must prepare and submit for the ANAC's previous acceptance a manual establishing procedures and policies. The manual is to be used for the conduction of operations by the flight-, ground-, and maintenance- personnel of the certificate holder.

The item 135.23 of this regulation determines that the manual must also contain procedures aimed at the conformity with the accident/incident notification requisites in accordance with SIPAER specific legislation.

The RBAC 135 (135.81) also states that the certificate holder must keep every hired person knowledgeable of the operative specifications applicable to the person's duties and responsibilities, in addition to providing the company pilots with the following updated information, so as to allow flight planning on-the-ground: [...] (c) Aircraft Equipment Manuals and Aircraft Flight manual, or equivalent documents.

Among the supervision objectives, the following ones are highlighted: determine conformity of the supervised object to the requirements of the legislation in force; verify aircraft airworthiness, and provide guidance to users and operators of the Civil Aviaton System.

1.20 Useful or effective investigation techniques.

Nil.

2. ANALYSIS.

According to the NSCA 3-13, the objective of the notifications of aeronautical occurrences is to keep the SIPAER informed of events of potential interest to the System, in order to allow pertinent procedures to be adopted opportunely.

Two days before the failure of the PR-NHC engine, an accident occurred in Recife (*Pernambuco* State), involving an aircraft of the same model (LET 410), which sustained engine failure after takeoff. All aircraft occupants (16 people) perished in the crash.

Although at the time it was not possible to correlate the factors which contributed to both occurrences, the level of alert then affecting the aviation industry suggested that the incident with the PR-NHC deserved special attention.

Moreover, there are examples of incidents which can be classified as serious incidents, such as serious failure in obtaining the required performance during the takeoff or initial climb.

The serious incident in question occurred on 15 July 2011, but the CENIPA only received the pertinent notification three days later (18 July), thanks to actions taken by the SERIPA 5.

The time elapsed between the occurrence and the notification to the CENIPA becomes especially relevant, since one the hypotheses raised by the aircraft and engine manufacturers for the failure of the right engine was the possible presence of contaminated fuel in the aircraft tank.

Although this hypothesis was later ruled out, the fact is that a delay in collecting data and samples (especially fuels and lubricants) after an occurrence may hinder or even prevent the investigation team from learning about the contributing factors.

Important pieces of information, which many times are crucial to the investigation process may be lost if immediate action (known in Brazil as *initial action*) is not taken in response to an accident/incident.

The tests conducted by the engine manufacturer, and described in the item 1.16, showed that when the throttles were moved from takeoff power to a lower power setting without switching off water injection, a flameout occurred in two of the twelve power reductions, corresponding to 16% of the total.

According to the DCTA, the flameout occurred on account of the instability of the flame, caused by the weakening of the air/fuel mixture.

The DCTA notes that the tests were approved for being conducted in a test bench, since the operation was not recommended by the manufacturer on account of the risks inherent to a possible engine flameout.

Without considering the details of the technical aspects presented by the DCTA, the very manufacturer recognizes and warns of engine flameout risks in the aircraft manual if water injection is not discontinued before the throttles are moved from takeoff power to a lower power setting.

The investigation of the serious incident with the PR-NHC revealed that the pilots and maintenance professionals working for NHT Linhas Aéreas were not aware of the procedure established in the *Operation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part Nº 0982404*, and of the risks associated with the failure to comply with the prescribed procedure.

In accordance with the legislation in force, and, especially, the RBAC 135, the operator is responsible for updating the aircraft equipment manuals and the aircraft flight manual, as well as their equivalents in such a way that the operation complies with the minimum levels of safety established by the manufacturer and by the Brazilian civil aviation authority.

During the process of investigation, the commission verified that none of the documents utilized by the pilots, and aimed at flight safety and standardization, mentions the alert afore commented, something that led these professionals to being unaware of this procedure, which, if not complied with, could result in engine flameout.

Flight safety was, therefore, seriously jeopardized.

The non-compliance with this procedure due simply to lack of knowledge on the part of the *NHT Linhas Aéreas* company pilots was the reason for the loss of power of the right engine shortly after the aircraft took off from SBCT.

3. CONCLUSIONS.

3.1 Facts.

a) The pilots held valid aeronautical medical certificates (CCF);

b) The pilots held valid technical qualification certificates (CHT);

c) The pilots had qualification and enough experience for the type of flight;

d) The aircraft had a valid airworthiness certificate (CA);

e) The aircraft weight and balance was within the prescribed limits;

f) The aircraft toook off from Curitiba Aerodrome (SBCT), destined for Caçador Aerodrome (SBCD);

g) There was no switch-off of the water-injection system before reduction of power;

h) When the aircraft was passing 400ft, there was failure of the right engine during the reduction of the power setting;

i) There was a warning issued by the manufacturer relative to the possibility of engine flameout when the power setting was reduced without switching off water-injection;

j) The captain took over the aircraft controls and safely landed the aircraft after complying with the checklist procedures;

k) The aircraft sustained no damage; and

l) None of the aircraft occupants was injured.

3.2 Contributing factors.

- **Training – a contributor.**

The pilots' lack of knowledge on the limitation established by the aircraft manufacturer relative to the switch-off of engine water-injection system shows that the training previously received did not guarantee fullness of the information necessary for flying the company L410UVP-E20 aircraft.

- **Support systems – a contributor.**

The *NHT Linhas Aéreas* pilots and maintenance professionals were not aware of the procedure established in the *Operation Manual Turboprop Engine – Models Walter M601E - Walter M601E-21, Manual Part Nº 0982404,* and of the risks associated with failing to comply with the mentioned procedure.

The investigation commission also verified that none of the flight safety and standardization documents utilized by the pilots mentioned the alert in question, resulting, therefore, in a serious jeopardy to flight safety.

4. SAFETY RECOMMENDATION.

A measure of preventative/corrective nature issued by a SIPAER Investigation Authority or by a SIPAER-Link within respective area of jurisdiction, aimed at eliminating or mitigating the risk brought about by either a latent condition or an active failure. It results from the investigation of an aeronautical occurrence or from a preventative action, and shall never be used for purposes of blame presumption or apportion of civil, criminal, or administrative liability.

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 prior to the publication of this report:

To the National Civil Aviation Agency (ANAC):

RSV (I) 004/2012 - CENIPA Issued on 31/01/2012

Verify whether the "*Operation Manual Turboprop Engine – Models Walter* M601E – *Walter* M601E-21, *Manual Part* n° 0982404 *page* 2-6" was listed among the documents prescribed for the process of validation and certification of the LET 410E aircraft and its engines.

RSV (I) 005/2012 - CENIPA Issued on 31/01/2012

Analyze the need of issuing an airworthiness directive or another pertinent document with the objective of ensuring that LET 410 aircraft operators comply with the prescriptions contained in the "O*peration Manual Turboprop Engine – Models Walter* M601E – *Walter* M601E-21, *Manual Part* n° 0982404 *page* 2-6".

RSV (I) 006/2012 - CENIPA Issued on 31/01/2012

Review the AFM and other documents utilized by operators of LET 410UVPE-20 aircraft, taking, as a reference, the prescriptions contained in the *Operation Manual Turboprop Engine – Models Walter* M601E – *Walter* M601E-21, *Manual Part* n° 0982404 *page* 2-6.

RSV (I) 007/2012 - CENIPA Issued on 31/01/2012

Evaluate the need of reviewing the process of certification of the LET 410UVPE-20 aircraft, focusing on the contents of the *Operation Manual Turboprop Engine – Models Walter* M601E – *Walter* M601E-21, *Manual Part* n° 0982404 *page* 2-6.

Recommendations issued at the publication of this report:

To the National Civil Aviation Agency (ANAC):

IG-532/CENIPA/2015 – 01 Issued on 03/06/2016

Alter the legislations addressing notification of aeronautical occurrences, in order to warn the regulated individuals or organizations of the obligatoriness of notifying the CENIPA or pertinent SERIPA (in accordance with the NSCA 3-13) about such occurrences.

To LET Aircraft Industries:

IG-532/CENIPA/2015 - 02 Issued on 03/06/2016

Include, in the *After Takeoff* procedures of the L410UVP-E20 aircraft Normal Procedures Checklist, one or more items determining the switch-off of water injection before the reduction of the power setting, and inform the crew about the updates.

IG-532/CENIPA/2015 - 03 Issued on 03/06/2016

Include, in the L410UVP-E20 Aircraft Flight Manual, Section 4, Normal Procedures, the alert contained in the Operation Manual Turboprop Engine – Models Walter M601E – Walter M601E-21, Manual Part n° 0982404 page 2-6, and inform the crew about the updates.

IG-532/CENIPA/2015 - 04 Issued on 03/06/2016

Include, in the L410UVP-E20 Aircraft Flight Manual, Section 7, Systems of Airplane, the alert contained in the Operation Manual Turboprop Engine – Models Walter M601E – Walter M601E-21, Manual Part n° 0982404 page 2-6, and inform the crew about the updates.

5. CORRECTIVE OR PREVENTATIVE ACTION ALREADY TAKEN.

None.

On june 3th 2016.