ROMANIA
MINISTRY OF TRANSPORTS
CONSTRUCTIONS AND TOURISM

Inspectorate of Civil Aviation
No._____ from ___/_____/2006

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FINAL REPORT
CONCERNING
THE TECHNICAL INVESTIGATION
OF AVIATION ACCIDENT

Operator: [redacted]
Aircraft: **LET L-410UVP-E**
Registration: **HA-LAR**
Date: **27.01.2005**
Place: **Iasi Airport**

WARNING

This REPORT presents data, analysis, conclusions and recommendations concerning flight safety belonging to the Technical Investigation Commission appointed by the Ministry of Transports, Constructions and Tourism of Romania to investigate the circumstances and causes of this accident.

The technical investigation was performed according to provisions of the Government Ordinance no 51/1999 concerning the technical investigation of the accidents and incidents in civil aviation, approved with modifications and completions through Law 794/2001 and according to the provisions of the Annex 13 to the Convention on International Civil Aviation – Chicago 1944.

The object of the technical investigation is to prevent the occurrence of accidents and incidents, by determining the real causes and circumstances having lead to the occurrence of this event and by establishing the necessary recommendations for the flight safety (OG 51/1999 Chapter II, Art. 5 para. 1) and it DID NOT HAVE AS PURPOSE to find responsible people, individual or collective responsibilities (OG 51/1999 Chapter II Art. 5 para. 2).

Consequently, the use of this REPORT for other purposes than the ones concerning the prevention of the occurrence of accidents and incidents could lead to wrong interpretations.

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SYNOPSIS

CLASSIFICATION:	ACCIDENT
REPORT:	No. [redacted]
Owner of the Aircraft:	[redacted]
Operator:	[redacted] (wet lease to [redacted])
Aircraft type:	LET L-410UVP-E
Nationality:	HUNGARY
Registration:	HA-LAR
Place of the Accident:	Iasi Airport – 300m from Iasi TWR, on the connection road from airport to town; geographical position N $47^0$10'801" E $027^0$36'647" (by GPS in WGS 84)
Date and Time of the Accident:	27.01.2005 / 06:12 UTC

On 27.01.2005, the airplane type LET L-410UVP-E, registered HA-LAR, operator [redacted] (wet lease to [redacted]), was involved in an accident which took place in the vicinity of Iasi Airport.

The accident was notified at the Ministry of Transports, Constructions and Tourism, the Civil Aviation Inspectorate by Executive ATC and APP/TWR Iasi Supervisor, according to the documents attached (Annex no 1). The investigation was conducted according to the Law approving OG no 51/1999 concerning technical investigation of the accidents and incidents within civil aviation.

RECOMMENDATIONS

As a result of the technical investigation, the commission appointed through O.M.T.C.T. no 65 / 27.01.2005, made 7 recommendations concerning the safety of the flight:

1. Operators should take appropriate measures that Crew training regarding observance of published flight procedures and CRM principles should be improved.
2. Operator should observe rules regarding crew duty and rest time.
3. CAA's should evaluate impact on crew performances for flight missions on un-pressurized cabin at altitudes over 9000 ft.
4. The foreign crews leased by Romanian operators should comply with the Romanian laws regarding the work/rest time (S.D.Av.C. C202 Order);
5. Annual inspections of FDR and CVR and calibration of the FDR system should be performed in accordance with the provisions of the Attachment D (Flight Recorders) to Chapter 6, 6.3 of the ICAO Annex 6 part 1 in order to assess the serviceability of the flight recorders.
6. Operator should observe the procedure of replacing empty oxygen bottles with full ones on the aircrafts with special attention to authorization of the procedure.
7. Operator should pay special attention on providing training on PAR procedure when its pilots are using airport equipped with PAR.

FACTUAL INFORMATION

1.1 History of the flight

On 27.01.2005, the aircraft type L-410 UVP-E, operated by [redacted] (wet lease to [redacted]), with call sign RDP 233, registered HA-LAR, with two crew members, was planned for a mail cargo flight, from Baneasa Airport (LRBS) to Iasi Airport (LRIA). Initially the departure from LRBS had been delayed from 04:30 UTC to 05:30 UTC, following a delay message (operational reasons). At 05:01 UTC, the flight crew called Baneasa TWR frequency asking for an earlier engine start-up. TWR approved the engine start-up.

The engines were started up at 05:05 UTC. The aircraft took off from RWY 07 of Baneasa Airport at 05:11 UTC, and followed the planned route at FL130 with transponder code A4002 with mode C activated.

The flight crew contacted Iasi TWR ATCO at 5:59:19 UTC. The Iasi TWR ATCO cleared the flight to enter the zone and gave the necessary information regarding the runway in use (RWY 15), meteorological and runway conditions. The aircraft was authorized to descend in accordance with the published procedure and was informed that PAR procedure will be used for landing.

At 06:06:48 UTC the flight crew reported the approach of the IAS radio beacon, and the Iasi TWR ATCO asked the pilot to report starting the procedure turn and the altitude 2630 ft (QNH). This altitude represents the intercepting level of the glide slope according to the published PAR procedure.

At 06:10:37 UTC the flight crew reported again the approach to the IAS radio beacon and the altitude 2000 ft (QNH). From this moment, the crew didn't use the frequency anymore. They never reported the start of the procedure turn for the final approach phase.

At 06:11 UTC, the Iasi TWR ATCO observed from the control tower the aircraft at a low altitude deviating to the right from RWY 15. The aircraft over passed the "meteorological building", suddenly turned right to the Ciric forest, and after a few seconds (06:12 UTC) impacted the ground in the forest. Post impact fire occurred.

Iasi TWR ATCO immediately applied the emergency procedures and the competent authorities were alerted for search and rescue operations. Fire brigade and rescue team were at the scene immediately. They extinguished the fire and found no survivors.

1.2 Injuries to persons

Injuries	***Crew***	***Passengers***	***Others***
Fatal	2	0	0
Serious	0	0	0
Minor/None	0	0	0

1.3 Damage to aircraft

The aircraft was totally destroyed and partially burned.

1.4 Other damage

There were no other damages reported.

1.5 Personnel information

1.5.1 Data on crewmembers

Pilot (captain)	Male, 54 years old
License	ATPL; Issued: 24.03.2004 HUNGARY CAA; Valid till 31.03.2005
Medical certificate	Valid till 04.02.2005
Flying experience	14314 hours, from which 1712 hours on the type, 462 hours in previous year. Limited experience in PAR approach.
Work time	26.01.2005, 19.00 (UTC): BSA-TSR-BSA; BSA-CLJ-BSA; BSA-IAS-till accident time (06.12 UTCT); **Total 11h10'**. **Overdue 01h12'** (in conformity with the Romanian regulations, the maximum work time is 10h00' – Ord. C202/15.02.1992)
Rest time	More than 8 hours

Note: Romanian CAA checked the Pilot Log Book, vol. 4 (found in a/c wreckage) for the captain, and found that he fulfilled all requisite of training and qualification demanded by the JAR FCL-1.

Pilot (first officer)	Male, 33 years old
License	CPL; Issued: 25.08.2004 HUNGARY CAA; Valid till 31.03.2005
Medical certificate	Valid till 28.08.2005
Flying experience	1302 hours, from which 552 hours on the type, 436 hours in previous year. Limited experience in PAR approach.
Work time	26.01.2005, 19.00 (UTC): BSA-TSR-BSA; BSA-CLJ-BSA; BSA-IAS-till accident time (06.12 UTC); **Total 11h12'**. **Overdue 01h10'** (in conformity with the Romanian regulations, the maximum work time is 10h00' – Ord). C202/15.02.1992)
Rest time	More than 8 hours

Note: Romanian CAA checked the Pilot Log Book, vol.2 (found in a/c wreckage) for the first officer, and found that he fulfilled all requisite of training and qualification demanded by the JAR FCL-1.

1.5.2 Data on ATCOs

Exe TWR ATCO	Male, 54 years
License	Valid till 23.11.2005
Qualifications	ADI/TWR, APS/RAD/PAR and OJTI
Mentions	-
Medical Certificate	Valid till 10.01.2006
Last course	Refresher 2004
Experience	28 years

Exe PAR ATCO	Male, 51 years
License	Valid till 01.12.2005
Qualifications	ADI/TWR, APS/RAD/PAR
Mentions	-
Medical Certificate	Valid till 17.05.2005
Last course	-
Experience	16 years

Note: After accident the alcohol test for the TWR/PAR Iasi traffic controllers has been done and the result was negative.

1.6 Aircraft information

Type of the aircraft	LET L-410UVP-E
Registration	HA-LAR
Manufacturer number	871923
Year of manufacture	1987
Time since new	6237 .09 hrs (at 25.01.2005)
Time since last overhaul	4145.40 hrs (at 25.01.2005)
Date of the last technical verification for the airworthiness certificate extension	10.02.2004
Right engine type	M 601E
Serial number	872002-E
Time since new	2004 h
Time since the last shop visit	263 h
Left engine type	M 601E
Serial number	904002-E
Time since new	2004 h
Time since the last shop visit	263 h

NOTE:

a) The aircraft does not have a pressurization system and an autopilot.

b) The oxygen masks are not equipped with microphones or communication. To perform the communication, the crew had to remove the oxygen masks.

c) JAR-OPS 1.775 prescribes how supplementary oxygen should be provided on non-pressurized aircrafts. Oxygen supply system must be implemented on each non-pressurized aircrafts flying above 10.000 feet. The vital amount of oxygen should be calculated based upon planned altitude and flight time in accordance with the Operation Manual. These JAR-OPS rules are transformed into Hungarian law by a Ministerial Order. The subject aircraft was equipped with GCE portable airborne medical oxygen system. Supplement 11 in Section 9 of the Aircraft Flight Manual contains the necessary rules. Section 7 of the AFM also mentions the Oxygen Equipment providing the part numbers of the cylinders and masks and a table on the necessary pressure on the pressure gauge of the oxygen cylinders depending on the cabin air temperature.

d) The limitation for the LET – 410 UVP-E are as follows:

$\mathbf{V_R}$=150km/h (81 KIAS)	**DryOpEmptyW** = 3980 kg
$\mathbf{V_2}$=155 km/h (84 KIAS)	**BasicOpEmptyW** = 4231 kg
$\mathbf{V_{MCG}}$=130 km/h (70 KIAS)	**MRW** = 6420 kg
$\mathbf{V_{MCA}}$=135 km/h (73 KIAS)	**MTOW** = 6400 kg
$\mathbf{V_{MCL(FLAPS\ 42^o)}}$=135 km/h (73 KIAS)	**MZFW** = 5840 kg
$\mathbf{V_{MCL(FLAPS\ 18^o)}}$=155 km/h (84 KIAS)	**Max Cargo in Comp A or B** = 500 kg
$\mathbf{V_{MCL(FLAPS\ 0^o)}}$=175 km/h (94 KIAS)	**Max Payload** = 1710 kg
Centre of Gravity Position Limit Between 25% and 28% MAC	

1.7 Meteorological information

Before take-off from Baneasa Airport, the crew has received the meteorological information file from the Bucuresti-Baneasa "Meteo Office" at 04:10 UTC, containing data on real weather condition from 04:00 UTC, the applicable TAF available for LRIA, and the No.1 and No.2 SIGMET messages issued by CNPMNA (Meteorological Watch Office Bucuresti) on 27.01.2005. At the same time, the crew was informed about the probability to have the weather conditions with turbulence and severe icing at the destination airport

- **TAF (LRIA):** from 27.01.2005, issued at 03:00 UTC, valid from 04:00 UTC to 13:00 UTC, wind 300^0, 5 m/s, visibility 5000 meters, snow, cloud amount broken 300 meters, overcast 1500 meters, from 04:00 UTC to 07:00 UTC, visibility will decrease to 1500 meters, snow with mist, cloud amount broken 150 meters, overcast 900 meters, from 07:00 UTC to 09:00 UTC, visibility over 10 km, cloud amount broken 900 meters, overcast 2400 meters;
- **SIGMET No.2:** from 27.01.2005, issued at 03:55 UTC, valid from 04:00 UTC to 08:00 UTC, by meteorological surveillance center (CNPMNA). In Bucharest FIR: moderate turbulence, occasionally severe icing conditions predicted for the west part of the 28^{th} meridian, under FL 120, and occasionally severe and moderate turbulence predicted for the east part of the 26^{th} meridian, under FL 100, stationary, without changes. The meteorological info is in ANNEX 9.
- At the establishment of the communication with Iasi TWR (05:59:17 UTC), the Iasi TWR ATCO provided the crew with the aerodrome meteorological information. The 05:30 UTC METAR was: **"RWY-in-use 15, wind 290º, 4 m/s,**

visibility 1400 meters, snow, mist, cloud amount broken 500 feet, overcast 4000 feet, temperature -4 degrees, dew point -4 degrees, QNH 0997 hPa. RWY is covered by wet snow, 100%, depth 5 mm, braking action medium to poor."

Concluding, the crew received the meteorological bulletin and was informed about the weather condition in the region of Iasi Airport (turbulence and severe icing).

1.8 Aids to navigation

At Iasi Airport the following aids for air navigation are installed:

TWR ATC unit which provide air traffic services, flight information within Iasi CTR and PAR (precision approach radar) on final approach phase.

Navigation aids:

- NDB (IAS) coord. 47º14'03.38"N/ 027º34'46.85"E, distance 3.23 NM to threshold RWY 15
- Marker coord. 47º12'47.81''N/ 027º35'42.17''E, distance 1.82 NM to threshold RWY 15
- Locator (F), coord. 47º11'42.30''N/ 027º36'29.67''E, distance 0.61 NM to threshold RWY 15
- PAR (precision approach radar) type RP-5G. Precision Approach Radar Service is provided on final approach phase on an assigned frequency (118,8 MHz) other then TWR frequency (119,2 MHz).

1.9 Communications

Frequency used by Iasi TWR was 119.2 MHz and the communication was understandable. The communication recordings were available to the commission and the respective transcript of the communication is in ANNEX 2

1.10 Aerodrome information

The Iasi Airport has a RWY of 1800 m length and 30 m width.

The declared lengths of the runway were as follows:

Runway	TORA	TODA	ASDA	LDA
15	1800	2150	1800	1800
33	1800	2200	1800	1800

RWY 15 of IASI Airport is equipped with approach lighting system CAT I (900m length). **No** system to visualize the glide slope.

1.11 Flight Recorders

1.11.1 FDR and CVR

A FDR system BUR-1-2G was installed on the aircraft. This system records the last 50 hours of operation on 12 tracks on a magnetic tape. The subassembly containing the magnetic tape is MLP-23-1 S/N 00255.

The accident flight is not recorded on the FDR.

The flights recorded on the FDR cover the time period from 17.11.2004 to 30.11.2004.

For the indicated airspeed, elevator position, RH engine torque and DC voltage the recorded data is always zero (no information). The aileron position and vertical acceleration show strong data jitter. The data evaluation was impossible. The radio height has a permanent offset (+53 ft on ground).

A CVR system (probably a Sundstrand AV-557 B but part number and serial number were not readable on the unit), was installed on the aircraft. From the aircraft technical documents, the last known CVR installed on aircraft on 31.08.2003 was s/n: 5385, p/n: 980-6005-050,

This CVR system records the last 30 minutes of operation on 4 simultaneous tracks (captain, first-officer, cockpit, passenger address) on a magnetic tape. The last 30 minutes of the accident flight were recorded on the CVR.

During the readout there was an attempt to adjust the speed using the 400 Hz electrical noise interference produced by the 115V/400 Hz power of the aircraft.

An electrical interference of 320 Hz with harmonics was present on the Cockpit Area channel. No audio information could be extracted from this channel.

The only useful information was extracted from the captain and first officer channels.
The language used by the crew was Hungarian (for cockpit discussions) and English for ATC communication.

ATC communications were synchronized based on ATC time.

Close to the end of the recording a sound similar to a horn was recorded twice for a very short time, when push to talk was activated.

No GPWS audio warnings were discovered. These warnings are recorded on the Cockpit Area Channel (no audio information could be extracted from this channel).

The CVR transcriptions can be found in ANNEX 2.

1.11.2 Other recordings

The radar imaging record equipment for the PAR RP-5G was INOP due to technical reason.

The recorded radar data were available from Bucharest ACC – Constanta location and are presented in ANNEX 3.

The last detected position of the aircraft was at 06:10:20 UTC, with altitude 2800 ft and ground speed 179 kts. The last calculated radar position was at 06:10:40 UTC, with unknown altitude and ground speed 180 kts. After this moment the track of the aircraft was reconstructed based on whiteness declarations (PAR controller, METEO officer and TWR controller).

1.12 Wreckage and impact information

The impact (the road between Iasi Airport and Iasi City) caused the total destruction of the aircraft due to the ground collision and the post crash fire. The aircraft crashed the ground almost on a vertical angle and on backside.

The impact location is 47°10'48" N / 27°36'28"E. This is:

- Across the RWY 15 on the right at 679 m from the centre line;
- Along the RWY 15 at 782 m from the threshold;

1.13 Medical and pathological information

The captain and the first officer died due to the politraumatic injuries caused by the crash.

The bodies were partially burned in the postmortem fire. The toxicological exam revealed no traces of ethylic alcohol, carbon monoxide or drugs in the blood of the two bodies. Further medical analysis was requested on the medical status of the captain from a specialist for diseases of internal organs based on the results of previous family doctor examinations and frequent (in every six months) aviation medical examinations. The expert's opinion was the following:

- Based on the information available the connection between the captain's heart and veins status and the cause of the accident cannot be established unambiguously (new heart-disease was not verified by the autopsy, but the heart was also partially burned), but in the veins that could be examined some calcification was found. The fibrositis found in the myocardium could be the result of some coronary artery disease.

- The captain had high heart and blood-vessel risk based on the information found. Obesity, high blood-pressure, pathological lipid levels existed surly, but there is not data on glucose intolerance. Metabolic syndrome based on the NCEP ATP III criteria can surly be diagnosed (the waist contour is unknown, but the given height and weight data show pathological changes), but the WHO/MDT criteria

cannot be used because the glucose intolerance was not examined. The criteria of the metabolic syndrome:

WHO / MDT	NCEP ATP III (USA)
• Glucose intolerance + 2 out of the 3: • Hypertonia • Diszlipidemia • Obesity	3 out of the 5: • Blood sugar on an empty stomach ≥ 6.1 mmol/l • Hypertonia • Triglyceride ≥ 1.7 mmol/l • HDL-C < 1.04 (male) or 1.29 (female) • Weist contour > 102 cm (male) or 88 cm (female)

- Annex 1 of the Hungarian Ministerial Order on aviation medical checks mentions several times that the blood lipids (cholesterols, triglyceride) should be determined to take the measure of the heart and blood vessels risk at the first examination at the age of 40. The captain's total cholesterols triglyceride level was high, no HDL or LDL cholesterols level was determined although these are essential to examine the risk and the plural after cholesterols shows that the Ministerial Order prescribe the determination of both of the cholesterols.
- The same Ministerial Order prescribes sugar burden examination only in the case of glucozuria or high blood sugar on an empty stomach, so this test was not done on the captain. Still it would be highly suggested to use the annual recommendations of the American Diabetes Society which says that type 2 diabetes mellitus test should be made at every person above the age of 45 whose Body Measure Index is above 25 kg/m^2 (the captain's BMI was 33,26 kg/m^2). In case of a type 2 diabetes mellitus first the after meal blood sugar level gets pathologically high, the blood sugar on an empty stomach remains normal for a long time.
- The status of flying at a high altitude with low oxygen pressure equals to the status of physical burden for the body. To use oxygen is a prescription but it cannot be controlled. The captain flew as an agricultural pilot before and he just recently started to fly at a high altitude. At this altitude with a possible stenosis the compensational increase of the circulation cannot be guaranteed and it can make lack of oxygen at the tissues.

1.14. Fire

The disintegrating aircraft caught fire after initial impact. The front and central part of the fuselage was burned, and also the central part of the wing.

There are no technical or forensic indications that fire broke out on the aircraft before its initial contact with the ground.

1.15. Survivability aspects

The crash occurred at high speed on concrete road. The resulting forces acting on the crew were not survivable.

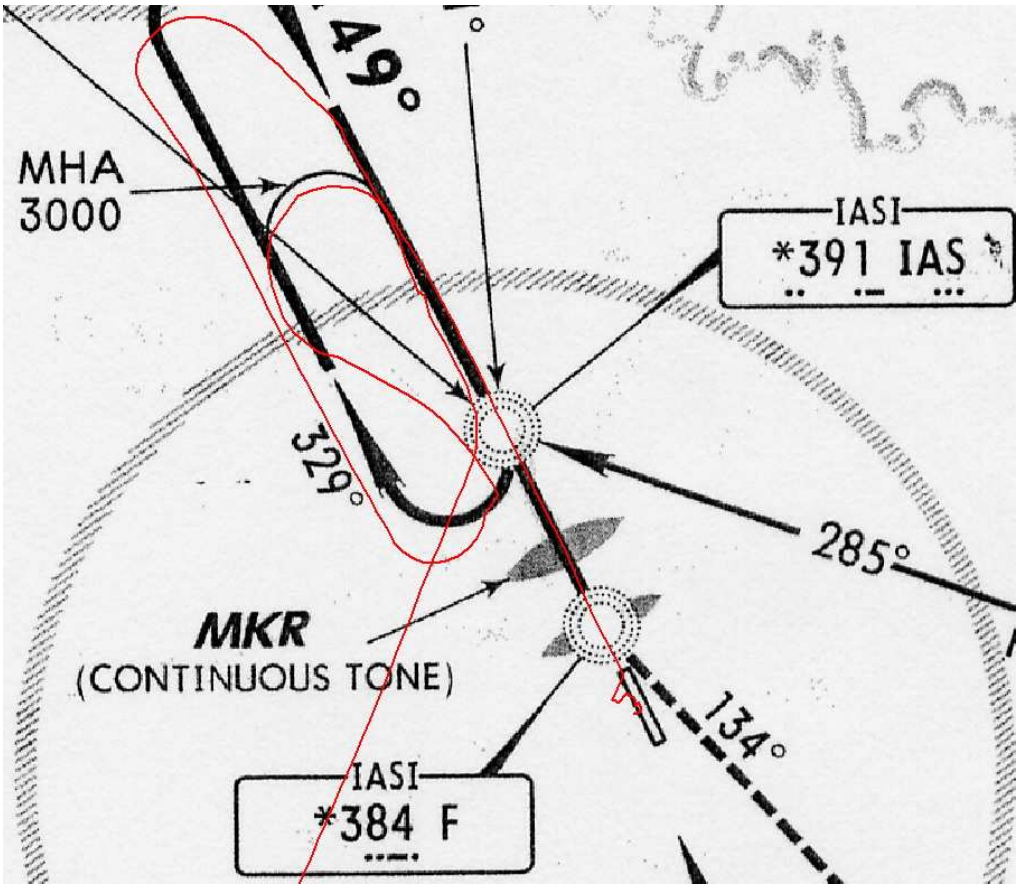
1.16. Tests and research

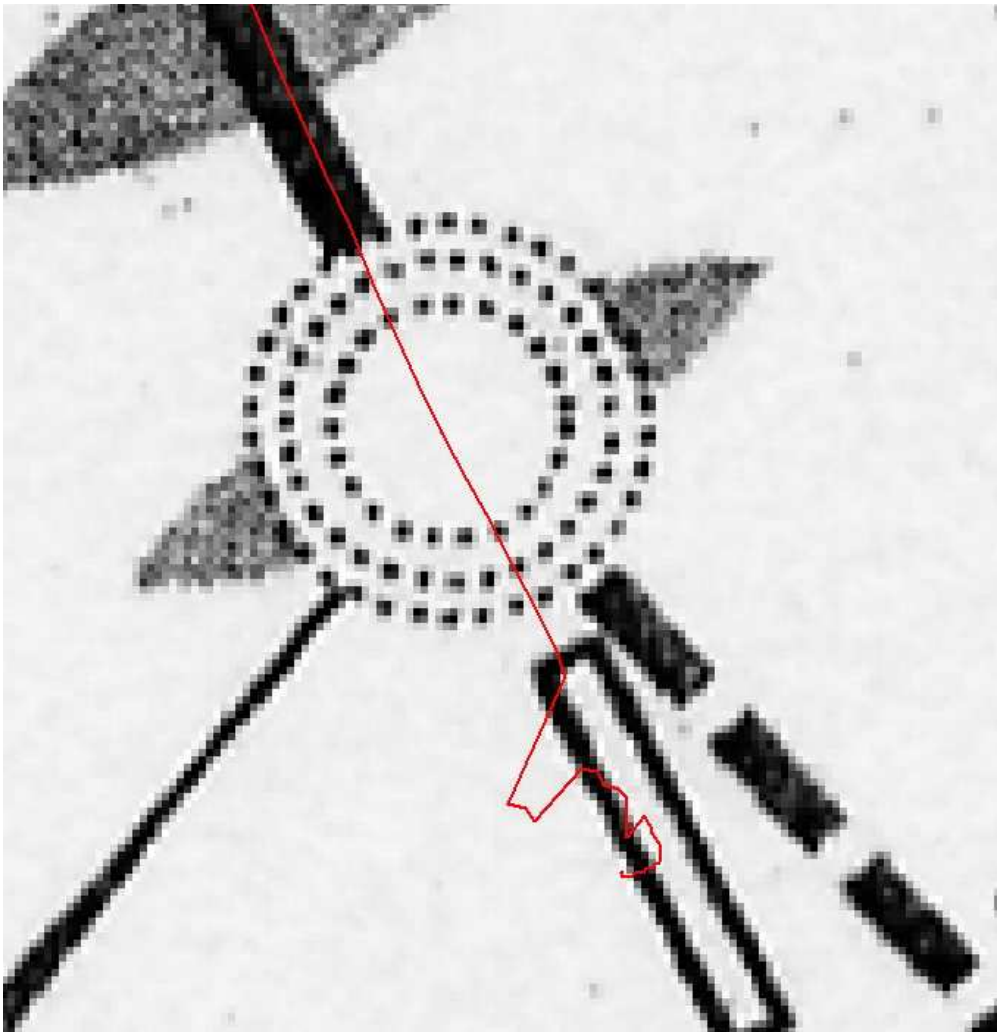
On the date of 06.04.2005 a flight test was performed using the same aircraft type in order to establish if the use of the GPS on board the aircraft for approach purposes could have contributed to the accident.

(GPS equipment is not authorized to be used for instrument approach procedure).

During this test, it was performed one approach to Iasi Airport according to the published PAR procedure and 3 different GPS's recorded the aircraft position.

The logged flight path is shown hereinafter:





The result of this test shows that the GPS data could be affected by the PAR radar frequency as shown in the figure above (the red line). However, in case the crew conducted the flight using GPS, they could follow an erroneous track during the short final approach. The amount of erroneous data could increase during icing condition.

1.17. Organizational and management information

The aircraft was operated by [redacted], and wet-leased by [redacted] to provide mail cargo flights in Romania and abroad.

The aircraft was maintained by [redacted]'s technical personnel in Bucharest – Romania for line maintenance and Budapest – Hungary for base maintenance.

[redacted] Headquarters are located in Basel (Switzerland), with a subsidiary in Budapest (Hungary). For more than 20 years [redacted] has been at the forefront in the field of European express air cargo transport and logistics. Utilizing important synergies with the parent company [redacted] Switzerland, [redacted] Hungary employs around 75 staff in the operation and maintenance of the F27 fleets. All L-410 aircrafts were sold by the company. In addition to standard aviation certification, JAR OPS 1 and EASA Part 145, governing all aspects of commercial operations, including Training, Operational Standards, Maintenance and Safety, [redacted] was one of the very first airlines in Europe, to introduce and apply a Quality Management System, certified according to ISO 9001-2000 Quality Standards (Certification Number 80064).

[redacted] is a small private company who fly under JAR-OPS1 requirements. In October 2003 they first acquired an operating license for commercial transport of persons and goods. This license is valid until 19 October 2006.

2 ANALYSIS

For the accident analysis the commission used the statements of witnesses, the ATC operators from TWR/APP, information provided by ATM equipment, the objective data offered by aircraft CVR, the recordings of the communications between TWR and PAR, the films and photos made at the crash site and also the investigation of the wreckage made by the members of the investigation team.

2.1 Analysis of the weather conditions

According to METAR at 05.30 UTC, weather information was:

- Wind 290° at 4 m/s
- Visibility 1400 m
- Snow, Mist, Cloud amount broken 500 ft, Overcast 4000 ft
- Temperature - 4°C
- Due point - 4°C
- QNH 997 hPa

At the time of the aircraft accident the weather conditions permitted PAR approach for RWY 15, however:

- RWY and airfield was covered by snow 100% and probably there was not a good visual reference;
- Existing tail wind at about 3.2 m/s and cross wind at about 2.6 m/s witch do not justifies the right deviation from runway heading;
- As a result of meteorological data and CVR analyses, at the time of accident there were icing conditions and the flight crew was aware and preoccupied about that.

This was confirmed by the request of captain to the F/O to operate the de-icing system. The efficiency of de-icing was monitored by F/O. The crew concluded that the ice “It isn’t accumulating” (06:02:29 UTC). Possible tail icing could not be observed from the cockpit.

2.2 Analysis of the technical state of the aircraft

At the time of the accident the aircraft had a valid Certificate of Airworthiness issued by the Hungarian CAA.
The FDR didn't record this flight, due to technical malfunction.

2.3 Analysis of the cargo movement on the directional and lateral stability and control

The technical commission prepared a load sheet for the aircraft based on the existing known data. There were considerate two possibilities of the cargo positioning: cargo in the compartment 2 and cargo on the Row 6 (see the schema below).

From the load sheet we can see that with the cargo weight positioned on Row 6 (red marks), the MAC for landing goes out of the range to 32% (range between 25% and 28%). That moves aft the Center of Gravity (C.G.) with 4%.
As the C.G. moves aft, the pilot's ability to control the pitch attitude can also be degraded. More and more trailing edge down elevator or stabilator is necessary to maintain a constant Angle of Attack (AOA). The airplane may run out of nose down control before it becomes statically unstable in pitch. In addition to causing problems during cruise flight, aft C.G.s can cause problems during takeoff and landing. Because of the extreme sensitivity of the airplane to pitch inputs while flying with an excessively aft C.G., rotation during takeoff and landing may be excessive, leading to premature lift-offs and stall during takeoff and excessively rapid or high flares and stall during landings.

That means that if the pilot tried to make the Go Around procedure and during rapid climbing the cargo has moved on the back side of the cargo compartment (Row 6), this change of the C.G. could have determined the stall of the aircraft.

This analysis could be assumed as a possible scenario only if we consider that the cargo moves back to the row 6. The commission didn't find any evidence that the cargo moved.

LOAD SHEET AND BALANCE CHART FOR CARGO VERSION
L-410 UVP, L-410 UVP-E

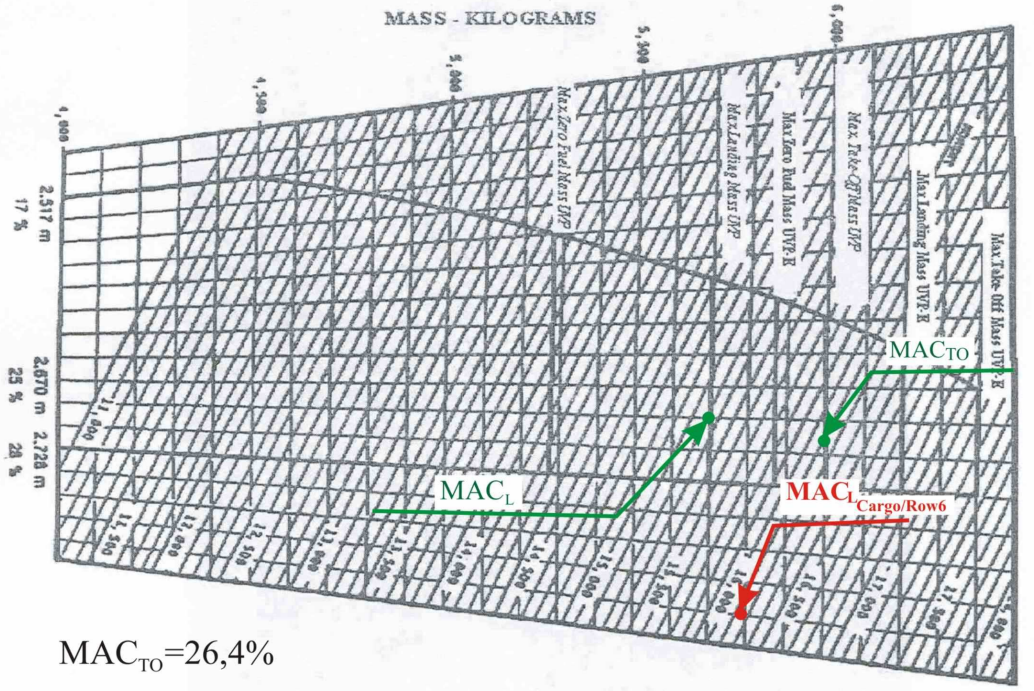
Date:	27.01.2005	*From:*	LRBS	*To:*	LRIS
Flight No.:	RDP233	*Reg:*	HA-LAR	*Filled by:*	

	Items		Mass	Moment
Trip	Main fuel		1000	3134
	Wingtip fuel		300	802
	TRIP fuel		300	-940
Zero fuel	FWD baggage			
	Add. Crew, PAX seat			
	Comp. 1			
	Comp. 2		465	1635
	ROW 6		465	2341
	TOTAL CARGO		465	1635
	Dry Op.Mass		4231	10546
	Zero Fuel Mass	5270/5840		
T/O	T/O FUEL	Block-20 kgs	1280	
	TAKE-OFF MASS	6000/6400	5976	16117
LND	*MINUS !!*	Trip fuel	300	-940
	LANDING MASS	5700/6200		15177
LANDING MASS cargo on ROW 6			5676	15883

Trip fuel

Last MIN. Change.	Mass	Moment
Z.F.M.		
L.M.C. FWD baggage +/-		
L.M.C. Add crew, Pax +/-		
L.M.C. Comp 1 +/-		
L.M.C. Comp 2 +/-		
L.M.C. Aft baggage +/-		
Corrected Z.F.M.		
TAKE-OFF MASS		
L.M.C. Total Cargo +/-		
L.M.C.Main Fuel +/-		
L.M.C.Wing tip Fuel +/-		
Corrected T/O.Mass		
TRIP fuel		
Corrected Landing Mass		

L.M.C. - Last Min. Change



MAC_{TO}=26,4%

MAC_{L}=25,8% $MAC_{L_{Cargo/Row6}}$=32 %

CAPTAIN S ACCEPTANCE

I hereby certify that this aircraft has been loaded in accordance with the current Loading Manual.

CAPTAIN'S SIGNATURE

2.4 Analysis of the aircraft operation

The analysis of the aircraft operation and of the route followed by the aircraft was made using the following data records:

- Plotting Map of route followed by aircraft, made by Romanian ATC - ROMATSA, using the recorded data from the radar equipment of ACC Bucharest – Constanta location.
- The magnetic records of the radio communications between the Iasi TWR and the aircraft.
- The magnetic records of the radio communications between the two pilots inside the aircraft.
- Wreckage investigation and impact side.

For analysis, the radar data were correlated with the air-ground communications (Iasi TWR ATCO – F/O) and ground-ground communications (Iasi TWR ATCO – ACC ATCO and PAR ATCO). At the same time the significant points were marked, the published approach standard procedure (PAR RWY 15) was traced and also the impact place was marked.

Name	North	East
FAP	$47^0$17’18”	$027^0$32’26”
IAS	$47^0$14’03”	$027^0$34’47”
F	$47^0$11’42”	$027^0$36’30”
RWY 15	$47^0$11’10”	$027^0$36’53”
RWY 33	$47^0$10’17”	$027^0$37’31”
Impact place	$47^0$10’48”	$027^0$36’28”

a. The aircraft arrival

The communication was normally transferred from ACC Bucharest – Constanta location to the Iasi TWR air traffic unit.

The aircraft entered the Iasi TWR air traffic unit frequency at 05:59:19 UTC, descending through FL 70 and received the clearance for FL 50. The ATCO provided the data for landing and received the confirmation from the flight crew.

The ATCO correlated the transition flight level from FL 40 to FL 50 due to the reported QNH, 997 hPa. According to the procedure, when the QNH drop with more than 10 hPa under the medium annually value, the ATC had the obligation to change the transition level. The crew confirmed the new transition level (FL 50).

The ATCO requested the flight crew to report the IAS vertical with FL 50 and transmitted instruction to the aircraft regarding the procedure to follow PAR RWY 15. The flight crew confirmed.

From ROMATSA radar plotting results as follows:
The instrumental approach procedure was incorrectly performed. The aircraft proceeded to the IAS NDB on FL 50 but never crossed the vertical of IAS beacon. The crew reported "Shortly IAS" at 06:06:48 UTC, being at 2,5 NM from NDB, with 153 kts, before doing the right turn to start the approach procedure. After the crew reported "Shortly IAS", at 06:06:53 UTC, the ATCO demanded the flight crew to "**Report starting procedure turn, 2630 feet".** The flight crew confirmed this instruction. The crew didn't cross the NDB but they flew almost along the procedure pattern, probably because they used for navigation the GPS information (GPS type: GNS-430, s/n: 96300816).

b. Initial Approach Phase

According to the published procedure, the aircraft must cross the vertical of the IAS beacon, go out from the beacon and turn left to fly inbound the beacon. In this phase, the aircraft must descend from FL 50 to 3000 ft (QNH).

From ROMATSA radar plotting results were as follows:

The crew didn't use this approach phase. The flight crew proceeded directly to land.

c. Intermediate Phase

According to the published procedure, after the initial approach phase, the aircraft must cross the IAS vertical, must turn right to heading 329^0 and maintain heading 329^0 for 2,5 min. In this phase the aircraft have to descend from 3000 ft (QNH) to 2630 ft (QNH).

After 2,5 min. maintaining heading 329^0 and reaching altitude of 2630 ft (QNH), the pilot must report reaching this altitude and starting procedure turn. After this, the aircraft have to be transferred to PAR controller. On PAR frequency, precision radar approach services are provided and the aircraft receives instructions regarding the approach direction and glide slope necessary for landing.

The crew did not perform this phase of the approach procedure and because of this they were never transferred to PAR frequency.

d. Final Phase

The final phase was initiated earlier and at higher altitude than the reference published on the procedure. The aircraft was not directed by PAR. The crew continued the final approach and descending without reporting this situation to TWR.

F/O was aware of the deviation from the procedure and made, 2 minutes before impact, an attempt to inform the captain that the approach procedure was not correctly performed. The captain ignored F/O's warnings (see CVR recording: 06.10.13 UTC Captain: *Tell him, that we are here!*; 06.10.19 UTC F/O: *Ah, no, we still have to go an other thing, don't we?*; 06.10.25 UTC Captain: *We are at IAS*, 06.10.28 *Tell him!*).

Concluding, the entry of the aircraft in the approach procedure and the subsequence phases were not in accordance with the published procedure;
SOP (Standard Operation Procedure) was not performed by the flight crew (the approach briefing, missed approach and go around procedure briefing not executed).

e. Impact

The aircraft hit the ground in an inverted position, at a roll angle of approx. 160º, in a nose down attitude, at a pitch angle of approx. 120**º.**

According to one of the airspeed indicators the aircraft hit the ground at a speed of 120 km/hour which is lower than speed limitation (see cap 1.6).

According to the mechanical position indicator of the LH main landing gear, it was locked in the up position.

According to the mechanical position indicator of the nose landing gear, it was not locked in the up position.

According to the mechanical position indicator of the RH main landing gear, it was not locked in the up position.

According to the measurements performed on the flaps actuator, the flaps were at an angle of between 18^{o} and 0^{o}.

According to thrust and propeller control levers position, propeller blades angle and engine instruments readings after impact the aircraft engines were operating at a high power setting (99% torque). The maximum take-off power setting corresponds to 100% torque or max. 735^{o}C ITT or 100% NG.

This is consistent with a witness declaration who stated that he saw the aircraft flying parallel to the runway to the right, climbing and turning right as he heard the engine noise increasing before it hit the ground on the access road to the airport in the forest.

The most probable assumption is that one of the pilots initiated a go-around procedure on the right side, increasing the engines power and selecting landing gear and flaps up. The aircraft stalled and collided to the ground when the flaps and landing gear were still in transit.

Concluding and taking into account the factual information and the data resulting from the analysis, the technical commission considers for the accident the following possible scenarios:

- Icing condition encountered in the descent phase;
- navigation using GPS information;
- aircraft in landing configuration (gear and flaps down);
- Deviation from the glide slope and track on the final approach because GPS data erroneous (PAR interference);
- Go around to the right with abrupt maneuver (steep turn), because:
  - A) no visual reference on ground and suddenly appearance of the TWR in front and left of the a/c; OR
  - B) the F/O initiated the Go-around on own decision and with no reaction from the captain (pilot incapacitation);
- gear and flaps retracted at low speed (not enough for the "clean" configuration and icing condition);
- stall (amplified by unfixed cargo);
- collision with leveled terrain;
- a/c post impact fire;

3 CONCLUSIONS

3.1 Findings

The Technical Investigation Commission for the accident that took place on the date of 27.01.2005 with the aircraft type LET L-410UVP-E, registered HA-LAR, in the vicinity of the Iasi Airport, found the following:

(1) The aircraft LET L-410UVP-E type, registered HA-LAR, belonged to [redacted] - Hungary, operated by [redacted] (wet lease to SC [redacted] SA – Romania);

(2) The aircraft type LET L-410UVP-E, registered HA-LAR, met the navigability conditions according to the Certificate of Airworthiness no 3929, issued by Hungarian CAA and this was within the validity term;

(3) On board of the aircraft type LET L-410UVP-E, registered HA-LAR, there were two pilots (captain and first officer) having the licenses issued by the Hungarian CAA, within validity term;

(4) The air traffic controllers (TWR and PAR) had licenses issued by the Romanian CAA, within validity term;

(5) The aircraft FDR did not recorded any data after 30.11.2004 due to technical malfunction. The problem was not documented even by crew or maintenance staff.

(6) From the CVR cockpit area microphone channel it was available a 320Hz frequency signal only.

(7) The operator failed to identify and correct the flight recorders defects.

(8) Ground radio navigation aids operated normally;

(9) Ground radio communication equipment operated normally;

(10) The Oxygen System is not suitable for continuous use because the oxygen masks are not equipped with microphones for communication.

(11) A quantity of 60 liters was found in right wing tip tank witch could produce a lateral unbalance of the aircraft especially in icing or stall conditions;

(12) The original Weight and Balance sheet was not presented until finishing the report. Using the existent data, the commission prepared a load sheet for the aircraft in order to verify the influence of the cargo movement on the directional and lateral stability and control.

(13) The only usable landing direction in the existing meteorological conditions was RWY 15 although there was a tail wind of 3,2 m/s;

(14) The Standard Approach Procedure authorized by Iasi TWR was PAR RWY 15. The Standard Approach Procedure published PAR RWY 15 complies with PANSOPS – Doc ICAO 8168 “Aircraft Operation Procedure”;

(15) The crew followed an approach procedure not complying with published Standard Approach Procedure (PAR RWY 15); the crew performed the final approach without an initial and intermediate approach;

(16) The beginning of the procedure turn wasn’t reported, so the aircraft wasn’t transferred to the precision radar. The crew continued the final approach and descent without reporting the situation to the Iasi TWR;

(17) The transmitted clearances and instructions were complying with applicable regulation;

(18) The chain of critical events was as follows:

(i) The aircraft encountered icing conditions during normal descent;

(ii) The aircraft deviated from the intended flight path (heading) during Initial and Intermediate approach;

(iii) The aircraft deviated from the intended flight path (heading and altitude) during Final approach;

(iv) The aircraft performed an incorrect missed approach and go around procedures;

(v) The aircraft stalled during go-around and collided with level terrain;

(vi) Aircraft fire occurred after impact;

(19) Inadequate CRM (Crew Resource Management) - no leadership, lack of communications;

(20) Both pilots had limited experience on PAR approach. The training records don't contain PAR procedure.

The investigation team considers that the aircraft can't be repaired under any conditions.

3.2 Causes of the accident

Favoring factors:

- The meteorological conditions: icing on ground and on altitude, snow on the airport and surrounding area, cloud amount broken 150m, visibility 1400m, RWY covered by wet snow one hundred percent (the flight crew may have had difficulty to early identification of the runway);
- The fatigue of the crew: at the accident time, the crew had already more then 11 hours of service, during night, flying on FL130, with an aircraft not equipped with automatic pilot and pressurization system;
- SOP (Standard Operation Procedure) was not performed by the flight crew (the instrument approach, missed approach and go around procedure briefing)

Determining causes

- Incorrect use of the published standard instrument approach procedure (PAR RWY 15);
- No use of the published missed approach and go around procedure: the stall of the aircraft due to a sudden and strong turn to the right and upwards and possible icing of the aircraft, in the same time with the retraction of the landing gear and flaps at a speed under the limits of a "CLEAN" aircraft configuration.

4 SAFETY RECOMMENDATIONS

As a result of the technical investigation, the commission appointed through O.M.T.C.T. no 65 / 27.01.2005, made the following recommendations concerning the safety of the flight:

1. Operators should take appropriate measures that Crew training regarding observance of published flight procedures and CRM principles should be improved; [**RF – SZ / 87 - 2006]**
2. Operator should observe rules regarding crew duty and rest time; [**RF – SZ / 88 - 2006]**
3. CAA's should evaluate impact on crew performances for flight missions on un-pressurized cabin at altitudes over 9000 ft; [**RF – SZ / 89 - 2006]**
4. The foreign crews leased by Romanian operators should comply with the Romanian laws regarding the work/rest time (S.D.Av.C. C202 Order); [**RF – SZ / 90 - 2006]**
5. Annual inspections of FDR and CVR and calibration of the FDR system should be performed in accordance with the provisions of the Attachment D (Flight Recorders) to Chapter 6, 6.3 of the ICAO Annex 6 part 1 in order to assess the serviceability of the flight recorders; [**RF – SZ / 91 - 2006]**
6. Operator should observe the procedure of replacing empty oxygen bottles with full ones on the aircrafts with special attention to authorization of the procedure; [**RF – SZ / 92 - 2006]**
7. Operator should pay special attention on providing training on PAR procedure when its pilots are using airport equipped with PAR. [**RF – SZ / 93 - 2006]**

Technical Investigation Commission – Members of the Commission

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