MINISTÉRIO DA ECONOMIA E DO EMPREGO
GABINETE DE PREVENÇÃO E INVESTIGAÇÃO DE ACIDENTES COM AERONAVES

PRELIMINARY ACCIDENT REPORT

Empresa de Meios Aéreos – EMA, S.A.

KAMOV KA-32A11BC

CS - HMO

Parque de Merendas de Espite
OURÉM

September, the 3rd, 2012

PRELIMINARY ACCIDENT REPORT Nr. 15/ACCID/2012

NOTES

In accordance with Annex 13 to the Convention on International Civil Aviation Organization, Chicago 1944, with European Parliament & Council Regulation nr 996/2010, from 20/10/2010, and nr 3 of art 11th of Decree Law Nr 318/99, from 11th of August, the investigation, analysis, conclusions and recommendations of this report are not intended to apportion blame or liability but, and only, to determine the causes of such accident and formulate recommendations that may prevent its repetition and to spread the lessons retrieved and capable of prevent futures accidents.

This preliminary report constitutes provisional information, based on findings gathered prior to its publication. It must be regarded as tentative and it is subject to alterations or corrections if, or when, new evidences are collected during investigation progress. The final report will be the official document containing definitive investigation results and will be published on GPIAA web page www.gpiaa.gov.pt.

This report has been released in Portuguese and English Languages. In case of conflict, Portuguese version will take precedence.

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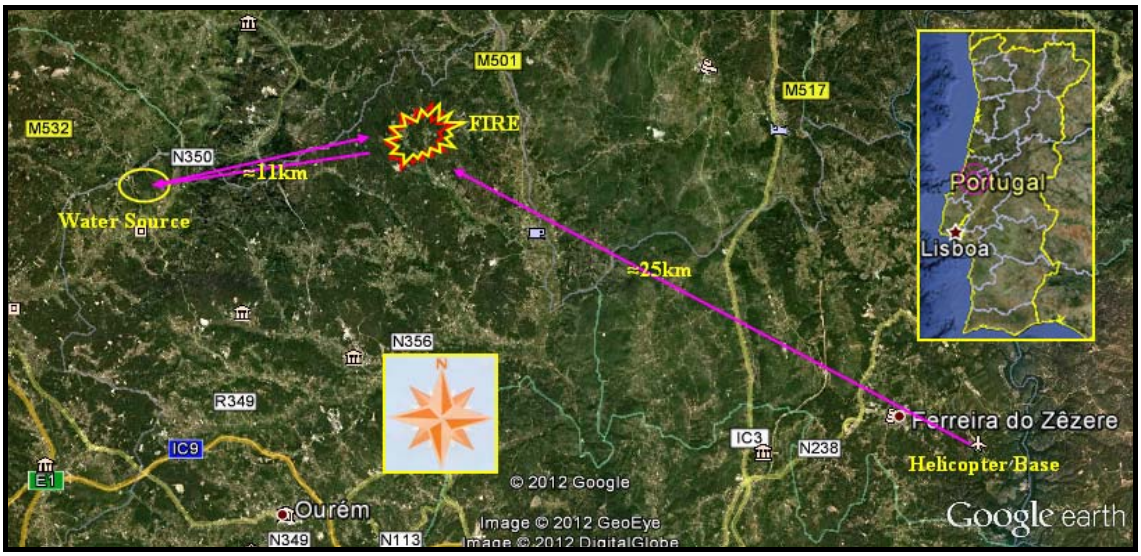
SYNOPSIS

On the 3rd of September, 2012, by 11:05[1], KA-32A11BC helicopter, s/n 9905, Portuguese registration CS-HMO, stationed at Ferreira do Zêzere, was called to perform a fire fighting mission, with "Bambi Bucket" installed, on a wild fire spreading at Ourém area (*picture nr 1*).



Picture Nr 1

The crew flew to the area and, once identified the target, searched for the previously assigned water source, a small lagoon near Espite, close to the fire, replenished the suspended "Bambi Bucket" and started his fire fighting mission.

After four water discharge manoeuvres, the pilot returned for another water loading. After restocking, when the helicopter was climbing and started to move forward, the pilot noticed one engine shutting down and the helicopter losing altitude, even with increased rotor collective pitch and the other engine accelerating to emergency power (*Extraordinary Mode)*. Without releasing the bucket, the aircraft crashed on the ground, in front (*picture nr 2*), with the other engine automatically shutting down.

Both pilots left the cabin by their own means, the Captain without injuries and the F/O with minor scratches and a broken toe phalanx.

The helicopter suffered substantial damage, with both rotors destroyed, front cabin was smashed, the tail became torn and the fuselage got some tears, dents and bruises.

Picture Nr 2

[1] - All times referred in this report, except other information, are UTC times (Universal Coordinated Time). On that date, local time, in Portugal mainland, was equal to UTC+1 hour.

1. ORGANIZATION OF THE INVESTIGATION

1.1 Notification

GPIAA was notified by the operator's Operations Department, by phone, at 11:15, followed by National Authority for Civil Protection (ANPC) and Republic National Guard (GNR). A GNR patrol mounted guard to the site, allowing only a rescue team to access the wreckage.

An investigation process was opened, with the appointment of the Investigator In Charge (IIC), who travelled immediately to the site and started the investigation, gathering the local evidences and testimonies, being the pilots taken to a hospital for medical examination.

Wreckage removal was authorized, by the IIC, being it moved to operator's facilities in Ponte de Sor, after combined voice/data recorder seizure.

Notifications were sent to involved States' Authorities, as per ICAO Annex 13, chap. 4.1.

1.2 Investigation Team

Air Accident Investigation Commission (AAIC), of Interstate Aviation Committee (IAC), representing the State of Design, State of Aircraft Manufacturer and State of Engine Manufacturer, appointed an Accredited Representative (ACCREP) and a list of advisors and experts from the Authority (IAC), helicopter designer (JSC KAMOV), Helicopter Service Co. (HSC) and engine designer (JSC KLIMOV).

The IIC requested the operator (EMA) and maintenance provider (HELISUPORT) to appoint their advisors and experts to join the Investigation Team (IT), which comprised:

Antonio Alves (IIC)	GPIAA	Valentin Sinitsyn (ACCREP)	IAC
Filipe Albuquerque (Advisor)	EMA	Tatyana Gorokhova (Expert)	IAC
Carlos Gonçalves (Expert)	EMA	Valentina Malysheva (Expert)	IAC
José Covas (Expert)	EMA	Sergey Katayev (Advisor)	KAMOV
Nuno Teixeira (Expert)	HELISUPORT	Ilya Romishevskiy (Expert)	KAMOV
Nuno Queiroz (Advisor)	HELISUPORT	Oleg Popov (Advisor)	KLIMOV
		Andrey Gerasimov (Advisor)	HSC

Table Nr 1

Besides the wreckage removal (due security reasons) and FDR downloading, all other investigation actions were frozen until the IT met for the first time, on the 13th of September, 2012.

On that first meeting, after member's presentation, an action plan was established and the works started with an exposition on prevailing flight and environmental conditions and a read-back of last minutes of the flight, extracted from CVR/FDR, which became the basis for that day subsequent studies, together with a trip of four elements to the site of the accident.

With wreckage and documentation stored at Ponte de Sor, next step was to move and continue the investigation there, with the results presented bellow.

2. FACTUAL INFORMATION

2.1 Human & Environmental

2.1.1 Flight Crew

Flight crew was composed by a Captain, male, Portuguese citizen, 46 years old, holding a ATPL(H) License and qualified to operate this type of helicopter, and a F/O, male, Portuguese nationality, 33 years old, holding a CPL(H) License, qualified to operate on this type of helicopter. Their last medical examination relates to 2012-05-29 and 2012-04-02, respectively, and both granted a medical class 1 qualification. Their flying experience, at 2012-09-03, as per table nr 2, below:

Flight Experience (Hrs)	**Captain**		**F/O**	
	Total	On Type	Total	On Type
Total	4 500	667:30	571:35	299:05
Last 90 days	37:35	37:35	18:55	18:55
Last 28 days	12:25	12:25	03:15	03:15
Last 07 days	08:20	08:20	00:45	00:45
Last 24 hours	04:50	04:50	00:30	00:30
Water discharges last 24 hours	45	45	5	5
Duty Period (Hrs)	Actual	Maximum	Actual	Maximum
Last 28 days	81:25	180	78:30	180
Last 07 days	22:10	60	19:00	60
Last day	04:35	12	04:35	12

Table Nr 2

2.1.2 Flight Operations

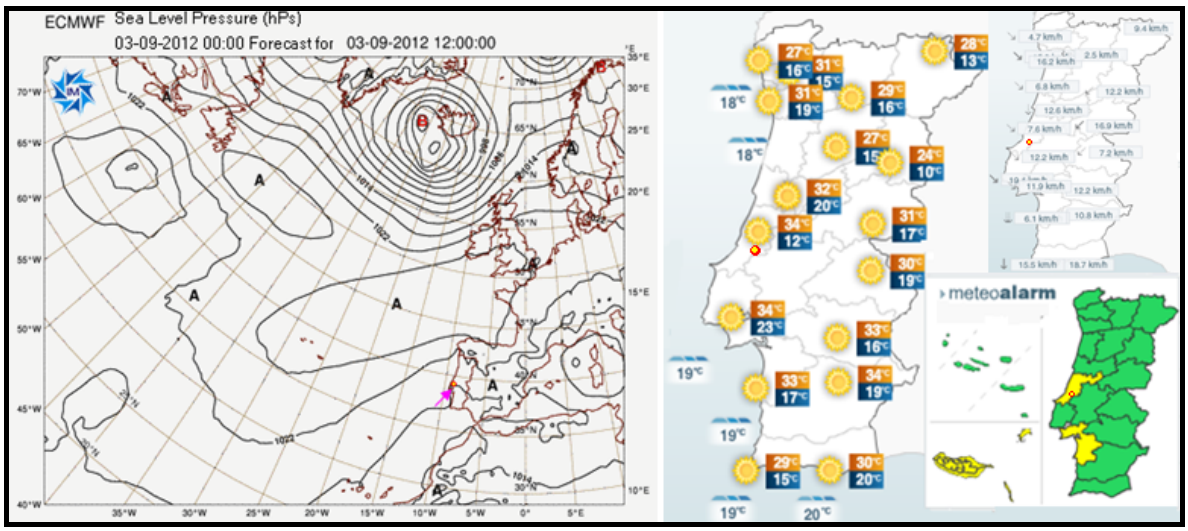
Required Manuals have been collected and an analysis process is in place to confirm the suitability and fulfilment of operational regulations & procedures, as defined by the operator and competent aeronautical authorities. At this moment there are no evidence of significant deviation from those regulations & procedures.

2.1.3 Ground Operations

At this stage of the investigation nothing points to any strange or inappropriate interference of ground services, which could influence the development of operations.

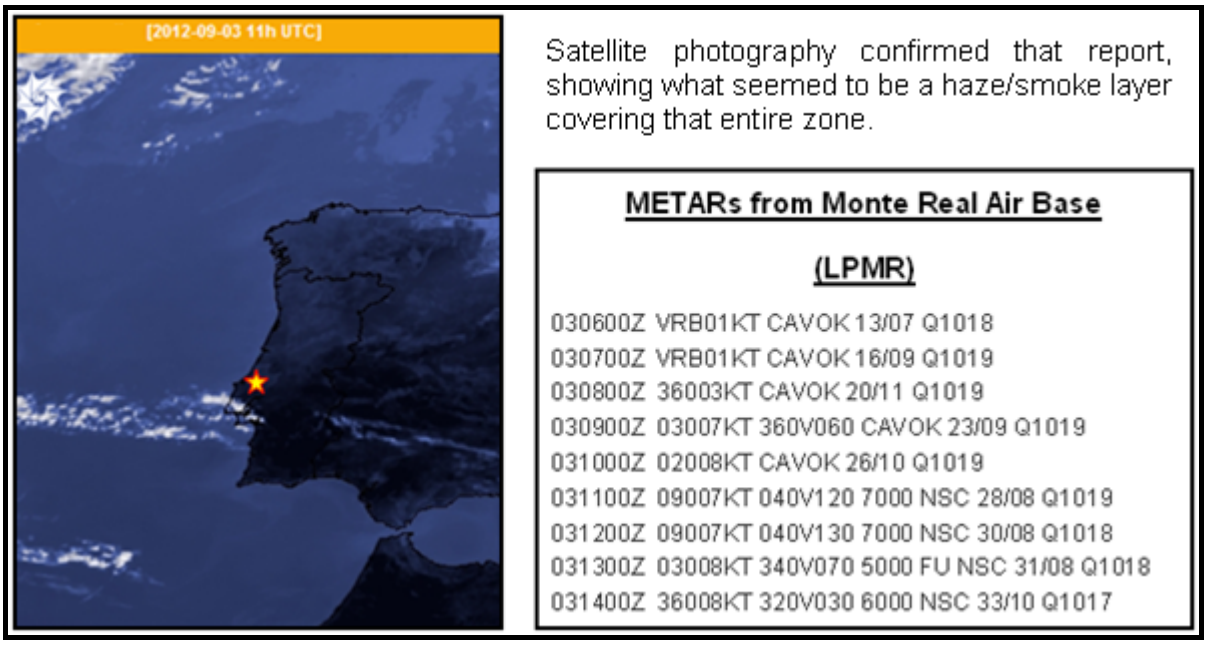
2.1.4 Meteorology

It was a nice summer sunny day being the country under the influence of a High Pressure System, which covered North Atlantic and a great part of Europe, Iberian Peninsula included, with wind calm to moderate, variable direction, sky clear and high temperatures, combined with low humidity. Meteorological Institute issued a yellow alarm for three districts, alerting for the risk of wild fires. Accident area was covered by this alarm (*picture nr 3*).



Picture Nr 3

Weather information from nearest airfield (Air Force Base of Monte Real) referred an Easterly wind with 7kt, variable between 040º and 120º, 7000m visibility, no clouds, 28ºC temperature and 1019hPs QNH (*picture nr 4*).



Picture Nr 4

2.2 Flight Recorders

2.2.1 PARS Aviation Service Co. 36H-2M Combined Flight Recorder

The aircraft was equipped with a combined FDR/CVR flight recorder 36H-2M, S/N 0375245, which was removed from the helicopter and kept in custody for downloading. Recording starts as soon as the aircraft becomes electrically powered and finishes when electrical power is removed, covering a data recording period of ± 50hours and ± 2hours of voice recording.

All available recordings were downloaded and stored but, for study purposes, the last flight (00:40:56) has been decoded and made available, only.

2.2.2 Audio Information

Voice recording has been retrieved from last flight (together with FDR data) and subjected to a hearing, looking for clues to determine when and how the accident took place, if standard procedures have been followed and to get a general view on cockpit crew load during flight.

No special circumstances that could influence cockpit environment seemed to be present. Pilots' voice tone looked normal and showing no stress or anxiety, performing normal communications and keeping a relaxed behaviour. Listening to the last minutes of surrounding sound pickup recording it was clearly audible the sound of engines shutting down and helicopter crashing on the ground noise.

2.2.3 Flight Data

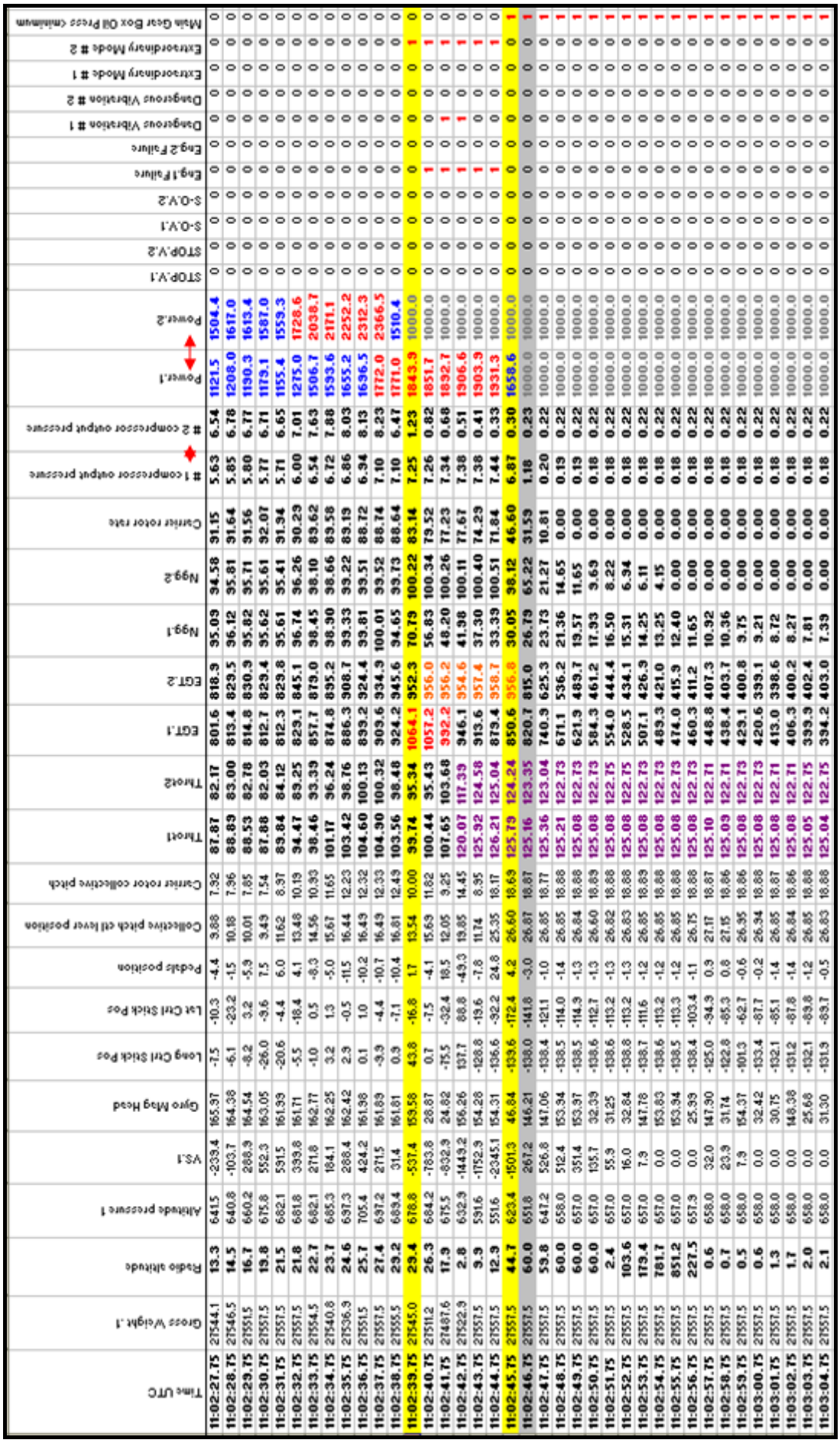
Even if there were several previous flights recorded, only the last one was decoded for analysis and presented to all Investigation Team members for study, together with an express analysis with the results of "Flight Information Processing", regarding "Messages" and other information, relating to that flight (*table nr 3*).

Messages

# Ev.	Time			Description
	Start	End	Duration	
				1. Stages of flight
S001	12:09:36.3	12:09:41.5	00:00:05.3	Wrong interval for information processing is selected - after engines were started Ngg.1,%[<]=92.5 Ngg.2,%[<]=92.1
S008	12:12:42	12:12:44	00:00:02	Touch down Alt.pr.1,foot[m]=653
				2. Pilot's action monitoring
S148	12:12:08.3	12:12:14	00:00:05.8	IAS is below minimum allowed value of 27 knots while flying above hovering ceiling without sling IAS.1,kt[-]=8.8 GW.1,lb[<]=27532 Gmax.1,lb[<]=24250 VS.1,ft/min[<]=-144
S161	12:12:39.3	12:12:42	00:00:02.8	Bank angle magnitude exceeds limitations while flying without external sling ABSroll,deg[+]=121.3 Alt.pr.1,foot[<]=579 IAS.1,kt[<]=8.8
S192	12:12:42	12:12:44	00:00:02	Landing place lateral slope exceeds limitation ABSroll,deg[+]=105.0
				3. Systems monitoring
S203	12:12:36	12:12:40.5	00:00:04.5	LEFT ENGINE OUT warning in flight activation Ngg.1,%[<]=56.8 EGT.1,deg[<]=1057
S206	12:12:34.5	12:12:40.5	00:00:06	EMERGENCY mode of the right engine while in flight Ngg.2,%[+]=100.5 EGT.2,deg[+]=959 COPr.2,kgf/sm2[+]=2.4 Power.2,hp[+]=1000
S211	12:12:34.8	12:12:37.3	00:00:02.5	Gas temperature of the left engine exceeds limitation of 990 degrees EGT.1,deg[+]=1073 Ngg.1,%[<]=75.6
S233	12:09:38.5	12:09:49	00:00:10.5	Carrier rotors' RPM in flight is more than 92% for more than 8 sec Ncr,%[+]=92.9 IAS.1,kt[<]=73.2 Ngg.1,%[<]=94.8 Ngg.2,%[<]=94.6
	12:10:29.8	12:10:48.3	00:00:18.5	Ncr,%[+]=94.3 IAS.1,kt[<]=68.2 Ngg.1,%[<]=96.7 Ngg.2,%[<]=96.7
	12:10:51.3	12:11:02.8	00:00:11.5	Ncr,%[+]=94.1 IAS.1,kt[<]=39.0 Ngg.1,%[<]=96.6 Ngg.2,%[<]=96.1
	12:11:11	12:11:58	00:00:47	Ncr,%[+]=93.5 IAS.1,kt[<]=53.1 Ngg.1,%[<]=96.0 Ngg.2,%[<]=95.7
	12:12:08.3	12:12:19.3	00:00:11	Ncr,%[+]=93.3 IAS.1,kt[<]=8.8 Ngg.1,%[<]=95.9 Ngg.2,%[<]=95.4
S234	12:12:35.3	12:12:42	00:00:06.8	Carrier rotors' RPM in flight is less than minimum allowed value of 83% (power is supplied) Ncr,%[-]=33.1 Ngg.1,%[<]=66.3 Ngg.2,%[<]=100.2
S243	12:12:36.5	12:12:38.5	00:00:02	Dangerous vibration, left engine Ngg.1,%[<]=52.0 EGT.1,deg[<]=1026 Ncr,%[<]=77.3 CLpCP,deg[<]=11.3
S274	12:12:36.3	12:12:42	00:00:05.8	Radio altimeter #2 in flight failure IAS.1,kt[<]=8.8 Alt.radi,foot[<]=25 Ngg.1,%[<]=54.2 Ngg.2,%[<]=100.4

Table Nr 3

With retrieved Flight Data, organized tables were constructed, looking for aircraft and engines performance, especially during the last minutes of the flight (*table nr 4*).



Time UTC	Gross Weight 1	Radio altitude	Altitude pressure 1	VS 1	Gyro Mag Head	Long Ctrl Stick Pos	Lat Ctrl Stick Pos	Pedals position	Collective pitch ctl lever position	Carrier rotor collective pitch	Trq1	Trq2	EGT 1	EGT 2	Ng 1	Ng 2	Carrier rotor rate	# 1 compressor output pressure	# 2 compressor output pressure	Power 1	Power 2	STOP V.1	STOP V.2	S-O.V.1	S-O.V.2	Eng.1 Failure	Eng.2 Failure	Dangerous Vibration # 1	Dangerous Vibration # 2	Extraordinary Mode # 1	Extraordinary Mode # 2	Main Gear Box Oil Press. (minimum
11:02:27.75	27544.1	13.3	641.5	-233.4	165.37	-7.5	-10.3	-4.4	3.88	7.92	87.87	82.17	801.6	818.9	35.09	94.58	91.15	5.63	6.54	1121.5	1504.4	0	0	0	0	0	0	0	0	0	0	0	0
11:02:28.75	27546.5	14.5	640.8	-103.7	164.38	-6.1	-23.2	-1.5	10.18	7.96	88.83	83.00	813.4	829.5	36.12	95.81	91.64	5.85	6.78	1208.0	1617.0	0	0	0	0	0	0	0	0	0	0	0	0
11:02:29.75	27551.5	16.7	660.2	288.9	164.54	-8.2	3.2	-5.9	10.01	7.85	88.53	82.78	814.8	830.3	35.82	95.71	91.56	5.80	6.77	1190.3	1613.4	0	0	0	0	0	0	0	0	0	0	0	0
11:02:30.75	27557.5	19.8	675.8	552.3	163.05	-26.0	-3.6	7.5	3.43	7.54	87.88	82.03	812.7	829.4	35.62	95.61	92.07	5.77	6.71	1173.1	1587.0	0	0	0	0	0	0	0	0	0	0	0	0
11:02:31.75	27557.5	21.5	682.1	591.5	161.93	-20.6	-4.4	6.0	11.62	8.97	89.84	84.12	812.3	829.8	35.61	95.41	91.94	5.71	6.65	1155.4	1559.3	0	0	0	0	0	0	0	0	0	0	0	0
11:02:32.75	27557.5	21.8	681.8	393.8	161.71	-5.5	-18.4	4.1	13.46	10.19	94.47	83.25	823.1	845.1	36.74	96.26	90.23	6.00	7.01	1275.0	1728.6	0	0	0	0	0	0	0	0	0	0	0	0
11:02:33.75	27554.5	22.7	682.1	271.8	162.77	-1.0	0.5	-8.3	14.56	10.33	98.46	93.39	857.7	879.0	38.45	98.10	83.62	6.54	7.63	1506.7	2038.7	0	0	0	0	0	0	0	0	0	0	0	0
11:02:34.75	27540.8	23.7	685.3	184.1	162.25	3.2	1.3	-5.0	15.67	11.65	101.17	96.24	874.8	895.2	38.30	98.66	83.58	6.72	7.88	1593.6	2171.1	0	0	0	0	0	0	0	0	0	0	0	0
11:02:35.75	27536.9	24.6	697.3	288.4	162.42	2.9	-0.5	-11.5	16.44	12.23	103.42	98.76	886.3	908.7	39.33	99.22	83.19	6.86	8.03	1655.2	2252.2	0	0	0	0	0	0	0	0	0	0	0	0
11:02:36.75	27551.5	25.7	705.4	424.2	161.98	0.1	1.0	-10.2	16.49	12.32	104.60	100.13	893.2	924.4	39.81	99.51	88.72	6.94	8.13	1696.5	2312.3	0	0	0	0	0	0	0	0	0	0	0	0
11:02:37.75	27557.5	27.4	697.2	271.5	161.89	-3.9	-4.4	-10.7	16.49	12.33	104.30	100.32	903.6	934.3	100.01	99.52	88.74	7.10	8.23	1772.0	2366.5	0	0	0	0	0	0	0	0	0	0	0	0
11:02:38.75	27555.5	29.2	693.4	31.4	161.81	0.9	-7.1	-10.4	16.81	12.43	103.56	98.48	924.2	945.6	34.65	93.73	88.64	7.10	6.47	1771.0	1510.4	0	0	0	0	0	0	0	0	0	0	0	0
11:02:39.75	27545.0	29.4	678.8	-537.4	153.58	43.8	-16.8	1.7	13.54	10.00	99.74	95.34	1064.1	952.3	70.79	100.22	83.14	7.25	1.23	1843.3	1000.0	0	0	0	0	0	0	0	0	0	1	0	
11:02:40.75	27511.2	26.3	684.2	-783.8	28.87	0.7	-7.5	-4.1	15.69	11.82	100.44	95.43	1057.2	956.0	56.83	100.34	79.52	7.26	0.82	1851.7	1000.0	0	0	0	0	0	0	0	0	0	1	0	
11:02:41.75	27467.6	17.3	675.5	-832.3	24.82	-75.5	-32.4	18.5	12.05	3.25	107.65	103.68	332.2	356.2	48.20	100.26	77.23	7.34	0.68	1832.7	1000.0	0	0	0	0	0	0	0	0	0	1	0	
11:02:42.75	27522.9	2.8	632.9	-1443.2	156.26	137.7	88.8	-43.3	13.85	14.45	120.07	117.39	946.1	954.6	41.98	100.11	77.67	7.38	0.51	1906.6	1000.0	0	0	0	0	1	0	0	0	1	0	0	
11:02:43.75	27557.5	3.9	591.6	-1752.3	154.28	-128.8	-19.6	-7.8	11.74	8.95	125.92	124.58	913.6	957.4	37.30	100.40	74.23	7.38	0.41	1903.3	1000.0	0	0	0	0	1	0	0	0	1	0	0	
11:02:44.75	27557.5	12.9	551.6	-2345.1	154.31	-136.6	-32.2	24.8	25.35	18.17	126.21	125.04	879.4	958.7	33.39	100.51	71.84	7.44	0.33	1931.3	1000.0	0	0	0	0	1	0	0	0	1	0	0	
11:02:45.75	27557.5	44.7	623.4	-1501.3	46.84	-139.6	-172.4	4.2	26.60	18.63	125.79	124.24	850.6	956.8	30.05	98.12	46.60	6.87	0.30	1658.6	1000.0	0	0	0	0	0	0	0	0	0	0	1	
11:02:46.75	27557.5	60.0	651.8	267.2	146.21	-138.0	-141.8	-3.0	26.87	18.87	125.16	123.35	820.7	815.0	26.79	65.22	31.53	1.18	0.23	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:47.75	27557.5	53.8	647.2	526.8	147.06	-138.4	-121.1	-1.0	26.85	18.77	125.36	123.04	740.9	625.3	23.73	21.27	10.81	0.20	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:48.75	27557.5	60.0	658.0	512.4	153.34	-138.5	-114.0	-1.4	26.85	18.88	125.21	122.73	671.1	536.2	21.36	14.65	0.00	0.19	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:49.75	27557.5	60.0	657.0	351.4	153.97	-138.5	-114.9	-1.3	26.84	18.88	125.08	122.73	621.9	489.7	19.57	11.65	0.00	0.19	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:50.75	27557.5	60.0	657.0	135.7	32.39	-138.6	-112.7	-1.3	26.60	18.89	125.08	122.73	584.3	461.2	17.93	3.69	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:51.75	27557.5	2.4	657.0	55.9	31.25	-138.6	-113.2	-1.3	26.82	18.88	125.08	122.75	554.0	444.4	16.50	8.22	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:52.75	27557.5	103.6	657.0	16.0	32.84	-138.8	-113.2	-1.3	26.83	18.88	125.08	122.75	528.5	434.1	15.31	6.34	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:53.75	27557.5	179.4	657.0	7.9	147.78	-138.7	-111.6	-1.2	26.85	18.89	125.08	122.73	507.1	426.3	14.25	6.11	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:54.75	27557.5	781.7	657.0	0.0	153.63	-138.6	-113.2	-1.2	26.85	18.88	125.08	122.73	483.3	421.0	13.25	4.15	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:55.75	27557.5	851.2	657.0	0.0	153.34	-138.5	-113.3	-1.2	26.85	18.88	125.08	122.73	474.0	415.9	12.40	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:56.75	27557.5	227.5	657.3	0.0	25.39	-138.4	-103.4	-1.1	26.75	18.88	125.08	122.73	460.3	411.2	11.65	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:57.75	27557.5	0.6	658.0	32.0	147.30	-125.0	-94.3	0.9	27.17	18.87	125.10	122.71	448.8	407.3	10.92	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:58.75	27557.5	0.7	658.0	23.3	31.74	-122.8	-85.3	0.8	27.15	18.86	125.09	122.71	438.4	403.7	10.36	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:02:59.75	27557.5	0.5	658.0	7.9	154.37	-101.3	-62.7	-0.6	26.35	18.86	125.08	122.73	423.1	400.8	3.75	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:03:00.75	27557.5	0.6	658.0	0.0	32.42	-133.4	-87.7	-0.2	26.34	18.88	125.08	122.73	420.6	399.1	3.21	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:03:01.75	27557.5	1.3	658.0	0.0	30.75	-132.1	-85.1	-1.4	26.85	18.87	125.08	122.71	413.0	398.6	8.72	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:03:02.75	27557.5	1.7	658.0	0.0	148.38	-131.2	-87.8	-1.4	26.84	18.86	125.08	122.71	406.3	400.2	8.27	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:03:03.75	27557.5	2.0	658.0	0.0	25.68	-132.1	-89.8	-1.2	26.85	18.88	125.05	122.75	399.3	402.4	7.81	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1
11:03:04.75	27557.5	2.1	658.0	0.0	31.30	-131.9	-89.7	-0.5	26.83	18.88	125.04	122.75	394.2	403.0	7.39	0.00	0.00	0.18	0.22	1000.0	1000.0	0	0	0	0	0	0	0	0	0	0	0	1

Table Nr 4

On first analysis it was noted there should be a mistake with engine readings associated with compressor output pressure (COPr.) and respective power calculations, considering the engine nr 1 was delivering power after shut down and engine nr 2 was running but delivering no power. When checking engine parameters during engine start it could be ascertained that those readings were reverted, with # 1 values corresponding to # 2, and vice-versa (*table nr 5*), supposedly due to a plug-in mistake.

Time UTC	Gross Weight.1	Radio altitude	Altitude pressure 1	Temp.1	Throt1	Throt2	EGT.1	EGT.2	Ngg.1	Ngg.2	COPr. 1	COPr. 2	STOP.V.1	STOP.V.2	S-O.V.1	S-O.V.2
10:23:42.75	27557.5	3.0	864.0	25.74	6.48	0.00	32.3	30.0	0.00	0.00	0.18	0.19	0	1	0	0
10:23:43.75	27557.5	3.0	864.0	25.51	6.48	0.00	32.3	29.7	2.12	0.00	0.18	0.19	0	1	0	0
10:23:44.75	27557.5	3.0	864.0	25.74	6.48	0.00	33.2	28.8	7.56	0.00	0.18	0.21	0	1	0	0
10:23:45.75	27557.5	3.0	864.0	25.75	6.48	0.00	35.9	28.7	9.71	0.00	0.18	0.22	0	1	0	0
10:23:46.75	27557.5	3.0	864.0	25.75	6.48	0.00	39.0	28.7	12.13	0.00	0.18	0.22	0	1	0	0
10:23:47.75	27557.5	3.0	864.0	25.75	6.48	0.00	41.9	28.7	13.97	0.00	0.18	0.22	0	1	0	0
10:23:48.75	27557.5	3.0	864.0	25.75	6.45	0.02	44.4	28.7	15.62	0.00	0.18	0.22	0	1	0	0
10:23:49.75	27557.5	3.0	864.0	25.75	6.43	0.02	72.1	28.7	17.38	0.00	0.18	0.22	0	1	0	0
10:23:50.75	27557.5	3.0	864.0	25.75	6.46	0.00	153.9	28.7	19.83	0.00	0.18	0.22	0	1	0	0
10:23:51.75	27557.5	3.0	864.0	25.75	6.48	0.00	233.7	28.7	22.35	0.00	0.18	0.23	0	1	0	0
10:23:52.75	27557.5	3.0	863.9	25.75	6.48	0.00	309.6	28.7	25.01	0.00	0.18	0.24	0	1	0	0
10:23:53.75	27557.5	3.0	864.0	25.75	6.48	0.00	383.5	28.7	27.91	0.00	0.18	0.32	0	1	0	0
10:23:54.75	27557.5	3.0	864.0	25.75	6.48	0.00	429.5	28.7	30.63	0.00	0.18	0.33	0	1	0	0
10:23:55.75	27557.5	3.1	864.0	25.75	6.48	0.00	451.2	28.7	33.18	0.00	0.18	0.36	0	1	0	0
10:23:56.75	27557.5	3.0	864.0	25.75	6.48	0.00	472.9	28.7	35.77	0.00	0.18	0.43	0	1	0	0
10:23:57.75	27557.5	3.3	864.0	25.75	6.48	0.00	490.8	28.7	38.35	0.00	0.18	0.47	0	1	0	0
10:23:58.75	27557.5	3.1	864.0	25.75	6.48	0.00	505.8	28.7	40.97	0.00	0.18	0.54	0	1	0	0
10:23:59.75	27557.5	3.3	864.0	25.75	6.48	0.00	514.4	28.7	43.60	0.00	0.18	0.62	0	1	0	0
10:24:00.75	27557.5	3.0	864.0	25.75	6.48	0.00	517.9	28.7	45.97	0.00	0.18	0.66	0	1	0	0
10:24:01.75	27557.5	3.3	864.0	25.75	6.48	0.00	519.5	28.7	48.26	0.00	0.18	0.74	0	1	0	0
10:24:02.75	27557.5	3.3	863.1	25.75	6.51	0.00	518.5	28.7	50.29	0.00	0.18	0.78	0	1	0	0
10:24:03.75	27557.5	3.1	863.9	25.75	6.50	0.00	514.5	28.7	52.08	0.00	0.18	0.88	0	1	0	0
10:24:04.75	27557.5	3.2	864.0	25.75	6.48	0.00	512.2	28.7	53.78	0.00	0.18	0.96	0	1	0	0
10:24:05.75	27557.5	3.0	863.0	25.75	6.48	0.00	515.9	28.7	55.72	0.00	0.18	1.06	0	1	0	0
10:24:06.75	27557.5	3.0	863.0	25.75	6.48	0.00	528.0	28.7	58.13	0.00	0.18	1.16	0	1	0	0
10:24:07.75	27557.5	3.0	863.0	25.75	6.45	-0.02	544.7	28.7	60.98	0.00	0.18	1.32	0	1	0	0
10:24:08.75	27557.5	3.0	863.0	25.75	6.46	-0.02	553.7	28.7	63.60	0.00	0.18	1.42	0	1	0	0
10:24:09.75	27557.5	3.0	862.0	25.75	6.48	0.00	556.6	28.4	65.42	0.00	0.18	1.54	0	1	0	0
10:24:10.75	27557.5	3.0	862.0	25.75	6.48	0.00	561.5	28.7	66.93	0.00	0.18	1.60	0	1	0	0
10:24:11.75	27557.5	3.0	862.0	25.75	6.48	0.00	569.2	28.7	68.61	0.00	0.18	1.67	0	1	0	0
10:24:12.75	27557.5	3.0	861.1	25.75	6.48	0.00	578.3	28.7	70.33	0.00	0.18	1.83	0	1	0	0
10:24:13.75	27557.5	3.2	861.0	25.75	6.48	0.00	593.6	28.7	72.66	0.00	0.18	1.97	0	1	0	0
10:24:14.75	27557.5	3.0	860.0	25.75	6.48	-0.02	603.4	28.7	74.72	0.00	0.18	2.05	0	1	0	0
10:24:15.75	27557.5	3.0	860.0	25.75	6.48	-0.02	600.2	28.7	75.62	0.00	0.18	2.10	0	1	0	0
10:24:16.75	27557.5	3.0	859.1	25.75	6.48	0.00	595.2	28.7	75.95	0.00	0.18	2.12	0	1	0	0
10:24:17.75	27557.5	3.0	859.0	25.75	6.48	0.00	589.6	28.7	75.91	0.00	0.18	2.10	0	1	0	0
10:24:18.75	27557.5	3.0	859.0	25.75	6.48	0.00	586.6	28.7	75.81	0.00	0.18	2.06	0	1	0	0
10:24:19.75	27557.5	3.0	859.0	25.75	6.51	0.00	585.8	28.7	75.69	0.00	0.18	2.05	0	1	0	0
10:24:20.75	27557.5	3.0	857.0	25.75	6.50	0.00	584.0	28.7	75.46	0.00	0.18	2.03	0	1	0	0

Table Nr 5

Once clarified the situation, it was possible to work on recorded data and proceed with flight analysis.

There were no significant events found during the operation until the two last minutes of flight, when it was noticed that, after “bambi bucket” refilling, when starting climb and forward motion, engine #1 shut down, engine #2 went to emergency power (*Extraordinary Mode*), but the helicopter lost altitude, which couldn’t be recovered with collective pitch increasing to maximum. The helicopter crashed with engine #2 shutting down 7sec after engine #1 failure.

Further FDR data analysis is in progress.

2.3 Material

2.3.1 Onsite Wreckage Examination

The wreckage was concentrated on the same place, with only parts of rotor blades spread for a larger area around the helicopter, which rested on its right hand side without heavy structure damage, but a broken tail and the front cabin smashed, especially on its right hand side (*picture nr 5*).

Picture Nr 5

The bucket was connected to the aircraft, being the release system not activated. It was dragged from the lake, across the road, until its resting place, spilling the water on its way (*picture nr 2*) and causing damage on helicopter's belly. Part of that water seems to be ingested by engine # 2, being seen some wet straws inside the air intake case.

2.3.2 Aircraft & Engines Identification

The aircraft, with Portuguese registration CS-HMO, was a twin engine, two concentric counter-rotating rotors (without tail rotor) helicopter, manufactured in 2007, with a valid Flying License, re-issued on 2012-02-13 by Portuguese Civil Aviation Authority (INAC), allowed to carry a Maximum Take-off Mass (MTOM) of 11000kg, seating 15 people, and the following technical references (*table nr 6*):

Reference	Airframe	# 1 Engines # 2	Rotors
Manufacturer	JSC KumAPE	JSC Motor Sich	JSC KumAPE
Type/Model	KA-32A11BC	TB3-117BMA Serie 2	D2B2000-O/B PS
Serial Nr	9905	3877892702121 - 3877892702122	301D2B4060014
T S N	1106:50	1105:44 - 1104:53	1106:50
T S O	1106:50	1105:44 - 1104:53	1106:50

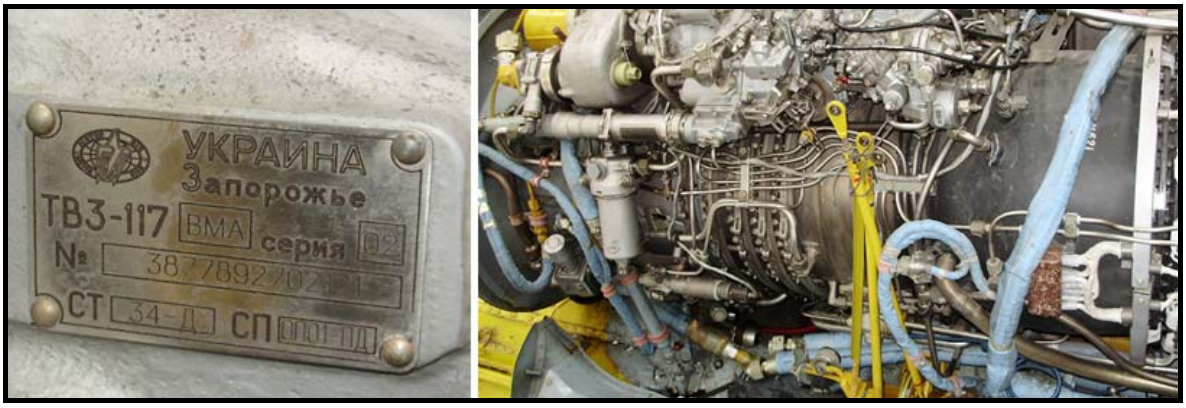
Table Nr 6

2.3.3 Engines Exterior Inspection

The wreckage was removed from accident site and store at operator's main base, inside a hangar and segregated to non-authorized people. After removing covers a visual inspection was carried out and noted that aircraft and its components were clean and properly maintained.

2.3.3.1 Engine # 1

TB3-117BMA series 02, s/n 3877892702121 engine was installed on helicopter left hand side (position # 1) and, externally, it looked proper and clean, with all accessories dully mounted and locking wires in place (*picture nr 6*).



Picture Nr 6

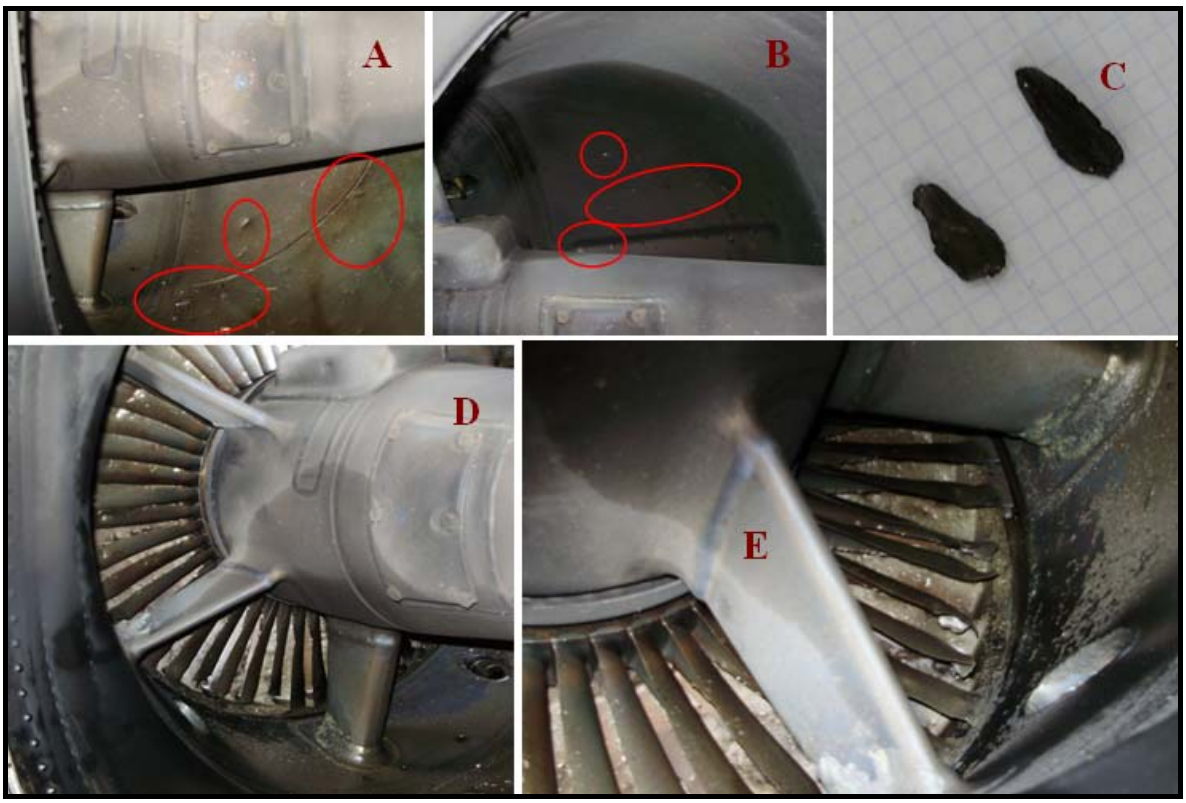
Picture Nr 7

After removing dust protection screen from engine air intake, some wet straws could be seen in air intake casing, probably ingested after impact with the ground and bucket's water spillage.

A front looking on compressor 1st stage rotor, showed a few blades slightly damaged due foreign objects impact during engine operation, well before the accident (*picture nr 7*).

Looking on engine rear side, escape duct linen was punched in a big area and showed to be perforated in some points, especially on the curved right hand side zone (*picture nr 8 A & B*).

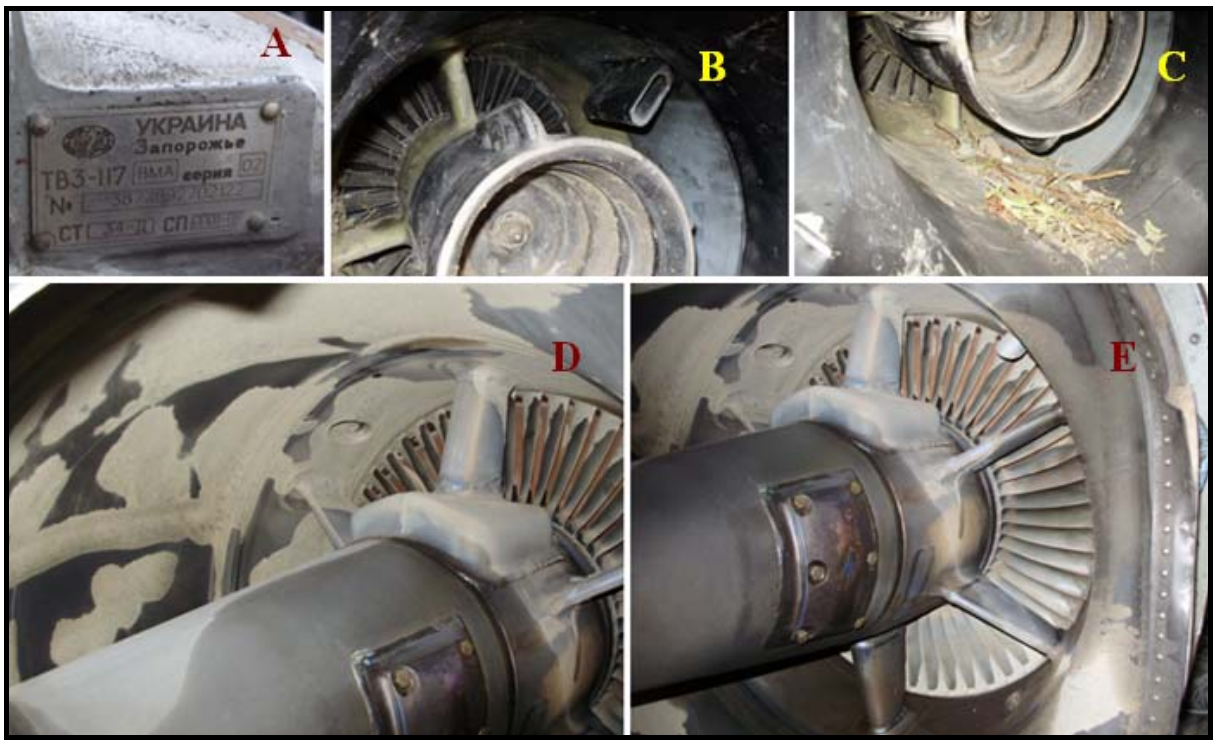
On the bottom of curved exhausted duct some small debris (2cm X 1cm) were found, coming from turbine blades breakage (*picture nr 8 C*). In fact, it could be seen free turbine 2nd stage rotor and NGV blades damage when looking from rear (*picture nr 8 D & E*).



Picture Nr 8

2.3.3.2 Engine # 2

On helicopter right hand side (position # 2), TB3-117BMA series 02, s/n 3877892702122 engine was installed (*picture nr 9 A*).



Picture Nr 9

Like the other one, it looked proper and clean. From a front view point, after removing dust protection screen, it was noticed a great amount of rubbish, consisting of vegetal waste, laying inside the air intake case, ingested when the engine rested on the ground and the bucket spilled its water. Otherwise compressor 1st stage rotor looked in good condition and fit for normal operation (*picture nr 9 B & C*).

Looking from the rear, free turbine looked fit but some stains and mud could be seen inside exhaust duct (*picture nr 9 D & E*).

2.3.4 Engines Borescopic Inspection

Next step was a borescopic inspection of the engines, using an "Olympus" type borescopic equipment and starting from the rear section.

2.3.4.1 Engine # 1

Free turbine second stage showed some fractured blades and nozzle guide vans, but first stage rotor was completely destroyed, with only some blade bits remaining. Compressor turbine stages one and two were absent or showing only some blade root pats, like respective NGV (*picture nr 10 A, B & C*).

Picture Nr 10

Compressor rotors and stators showed a normal condition, considering operating time, with only small marks & dents on some rotor blades (*picture nr 10 D, E & F*).

2.3.4.2 Engine # 2

Engine # 2 borescopic examinations showed no abnormal condition at any particular section of the engine, but expected normal wearing and erosion, with one rotor blade showing an abnormal dent, only (*picture nr 11*).

Picture Nr 11

Inside compressor casing, as in all internal airflow path, it was visible a great amount of slush and crystals, most probably derived from the water and dirty ingested by the engine after its crash on the ground.

2.3.5 Engines Records

All engine logs and records were looked into and evaluated based on appropriate Manual's recommended procedures, issued by the designer and accepted & certified by the Aeronautical Authorities.

On a preliminary examination of engines' records, the following discrepancies were noted:

- There is no registry of limited modes (take-off & max. continuous) of operation;
- Some kind of engine adjustment has been performed in engine # 1 electronic control governor (EEG), but it was not recorded on engine Logbook, only on Technical log;
- There was no registry of operational assessment of engine parameters on respective chapter of Logbook, as per Maintenance Manual, but all FDR recordings are stored on digital support;
- Engine maintenance has been carried in accordance with "*TB3-117 Turboshaft Engine Maintenance Manual 078.00.5800-04 P3-C*" procedures and recommended practices, instead of "*TB3-117 Turboshaft Engine Maintenance Manual 078.00.5800-04 P3*", as established by last "*KA-32A11BC Technical Publication Index*", issued 2012-03-01.

This subject needs to be examined more deeply and all its implications should be assessed on the light of the specific operational conditions of the fleet and the manufacturer's recommended procedures for this particular operator, since the helicopters entered in service, and have been the scope of Aeronautical Authority's Audits & Inspections performed along these years.

3. PRELIMINARY FINDINGS

At this point, the following findings may be enumerated:

1st - On the 3rd of September, 2012, helicopter KA-32A11BC, S/N 9905, registration CS-HMO, stationed at Ferreira do Zêzere, was assigned to a forest fire fighting mission;

2nd - During that mission, the crew performed several exercises of water spreading on the fire, with corresponding water refuelling manoeuvres from a small lake in the vicinity;

3rd - On one of these manoeuvres, the helicopter suffered an engine # 1 failure, when recovering from water restocking;

4th - Engine # 2 reverted to "*Extraordinary Mode*" and accelerated to emergency power, increasing power output up to 1931.3hp, maximum;

5th - External load (Bambi Bucket) was not released by the crew;

6th - The helicopter crashed on the ground about 10m ahead of its initial position;

7th - After the crash, engine # 2 automatically shut down;

8th - Pilot on left hand seat (Captain) escaped unhurt while pilot on right hand seat (F/O) suffered minor injuries and a broken toe phalanx;

9th - The helicopter suffered substantial damage;

10th - On a preliminary investigation, engine # 1 was found with turbine section destroyed by heat & mechanical breakage, especially on compressor turbine nozzles & rotors and free turbine stage # 1 rotor and NGVs;

11th - Engine # 2 looked in normal condition but with mud deposits inside entire air flow path, from intake to exhaust.

4. FOLLOW-UP ACTIONS

In order to ascertain the causes of the accident, the following actions were implemented:

1st - Engine # 1 detailed examination, with disassembly and further testing, at designer's facilities, with the presence of all interested parties;

2nd - Engine # 1 parts & components (including Temperature Control Unit – PT-12-6) examination and dedicated tests, as necessary;

3rd - Deep analysis of data recorded, in particular engines' performance data and flight progress;

4th - Operational and maintenance procedures and practices evaluation and comparison with retrieved data and approved manuals' recommended practices & procedures.

5. INTERIM SAFETY MEASURES

Being following maintenance procedures stated on "*TB3-117 Turboshaft Engine Maintenance Manual 078.00.5800-04 P3-C*", since the fleet entered service in 2008, when "*KA-32A11BC Technical Publication Index*", issued 2012-03-01, was received in 2012-04-02, HELISUPORT (maintenance services provider) contacted the manufacturer in order to clarify the situation and obtain confirmation of new maintenance procedures.

While waiting for reply, the previous procedures were maintained and the fleet continued flying usual assigned missions. After the accident, still waiting for an answer to his request, KA-32A11BC fleet was grounded until the situation becomes clarified.

Meanwhile a new engine cycle counting was performed, based on "*TB3-117 Turboshaft Engine Maintenance Manual 078.00.5800-04 P3*" recommended procedures, and affected engines (with life time expired) were removed.

Civil Aviation Authority was informed and the operator put on standby, waiting for confirmation or reissue of Flight Licenses, in the light of compliance with procedures stated on "*TB3-117 Turboshaft Engine Maintenance Manual 078.00.5800-04 P3*" or any other approved regulation.

Lisbon, 08th of November, 2012

António A. Alves
(IIC)