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MINISTÉRIO DA ECONOMIA E DO EMPREGO

GABINETE DE PREVENÇÃO E INVESTIGAÇÃO DE ACIDENTES COM AERONAVES

FINAL ACCIDENT REPORT

AVIALSA T-35

AIR TRACTOR - 802A

EC-JLB

"Roxo Dam"

BEJA

July, the 19th, 2012

GPIAA
Homologo, nos termos do nº 3 do artº 26º do D. L. 318/99, de 11 de Agosto de 1999
04.DEC.2012

O Director,

Fernando Ferreira dos Reis

FINAL ACCIDENT REPORT Nr. 12/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 report has been released in Portuguese and English Languages. In case of conflict, Portuguese version will take precedence.

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SYNOPSIS

The aircraft was performing a fire fighting mission on a wild fire in Caldeirão mountains, Tavira council, Algarve, integrated in a group of four similar aircrafts. After refuelling at Air Force Base Nr 11, Beja, they took-off, by 12:10UTC[1], and flew in formation towards "Roxo" dam, where they intended to make a scooping and proceed to the fire.

EC-JLB was the last aircraft (nr 4) to ditch, keeping standard formation, in line to the left, and trying to avoid the waves created by preceding aircrafts on lake surface. Near "lift-off", after water refuelling, the aircraft was involved by wake turbulence from other aircrafts. The pilot lost control of the aircraft and, when he managed to regain control the aircraft was pointing about 45º to the left. Before it could lift-off, both floats collided with the ground, in the margin, the left one detached, the aircraft flew over a small neck of land and crashed in the water, some meters ahead, loosing the right float and sinking.

The pilot escaped from the cockpit, unhurt, and swam to the margin, with life jacket help, from where he has been recovered by a military helicopter and transported to Beja Air Force Base.

GPIAA was notified by phone, by National Authority for Civil Protection (ANPC), at 13:28, followed by Beja Air Force Base Safety Officer and operator's Proença-a-Nova operational base manager.

[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.

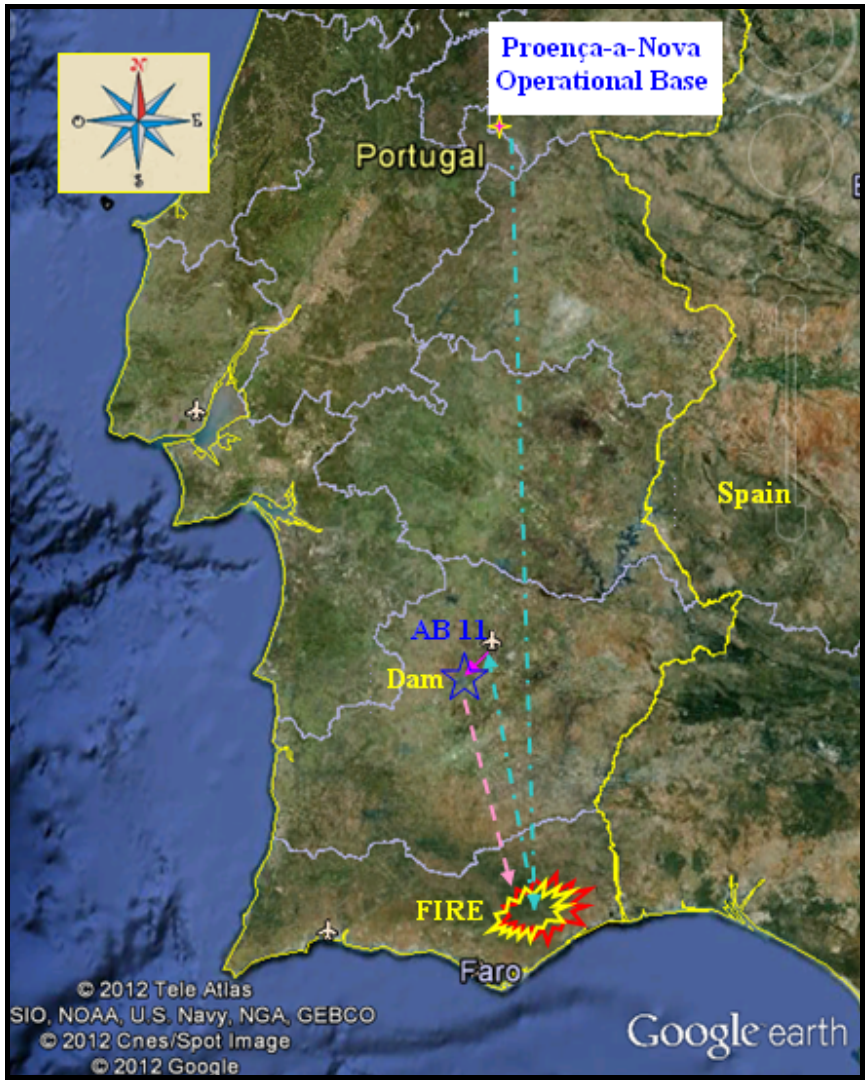
1. FACTUAL INFORMATION

1.1 History of the Flight

The aircraft (with a single pilot aboard) was performing a fire fighting mission, against a wild fire spreading in Caldeirão mountains, Tavira council, Algarve, integrating a group of four similar aircrafts (two teams).

The aircrafts departed from their operational base (Proença-a-Nova) by 07:25, flew to the fire area, where they discharged their product and proceeded to Beja military aerodrome (Air Force Base nº 11) for fuel refuelling and the pilots to have a short rest period (less than 2 hours).

By 12:10, both aircraft teams took-off in sequence, heading to "Roxo Dam", close to the aerodrome, where they expected to make water refuelling, prior to proceed to fire area again (*picture nr 1*).



Picture Nr 1

Being the second team wing aircraft, EC-JLB was the last (nr 4) to ditch, for scooping, being positioned to the far left, in order to avoid surface waves created by preceding aircrafts, using the virtual water runway, starting from right hand side.

After refuelling, the pilot accelerated for take-off and, when close to lift-off speed, entered wake turbulence zone, created by preceding aircrafts, got serious control problems, actuated emergency water discharge lever and when control was recovered, the aircraft was pointing about 45º to the left of intended heading. Before he could lift-off, aircraft floats collided with the ground in the lake margin and left float detached. The aircraft flew over a small

neck of land and crashed, nose down, some meters ahead in another inlet, right float broke up (becoming afloat and drift) and the aircraft sunk, almost immediately (*picture nr 2*).

Picture Nr 2

The pilot managed to evacuate the aircraft and, with life jacket help, swim to the margin, where he has been recovered by a Portuguese Air Force (FAP) helicopter and transported to Air Force Base Nº 11 (Beja). Here he was submitted to a preliminary medical examination, to evaluate his health general status and, showing no symptoms requiring special care, he was released and taken home.

1.2 Injuries to Persons

The pilot, the only person on board, got out unhurt (*table nr 1*).

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Light	0	0	0
None	1	0	0

Table Nr 1

1.3 Damage to Aircraft

The aircraft suffered substantial damage, which could justify not to be repaired, namely both floats separation and heavy damage to their fixing points and floats themselves, left wing tip and outer wing damage caused by water impact, right wing underwing crack (near its root) with fuel tank leak, bent propeller blade tips and light damage (scratches and dents) on fuselage skin and flight control surfaces (*picture nr 3*).

Picture Nr 3

Being the aircraft immersed in the water it's supposed to have suffered equipment and engine substantial internal & external damage.

1.4 Other Damage

There are no other damages reported, but small fuel leakages that have been readily controlled, avoiding dam water pollution.

1.5 Personnel

On board there was only the PIC, Portuguese citizen, male, 63 years old, holding a Commercial Pilot License (CPL(A)), duly qualified to operate this type of aircraft and performing this type of mission and showing the following flying experience (*table nr 2*):

Flight Experience (hours):	**Total**	**On Type**
Total:	9950	590
Last 90 days:	37:35	37:35
Last 28 days:	14:10	14:10
Last week:	08:55	08:55
Last 24 hours:	04:50	04:50
Landings during last 24 hours:	19	19

Table Nr 2

His flying license was valid until 09-11-2015 and he was present to an aeronautical medical examination on 01-02-2012, being classified as “class 1” with the restriction of wearing corrective lenses and to carry a set of spectacles.

During the last four weeks, prior to the accident, he accumulated the following Flight Duty Times (*table nr 3*):

Flight Duty Time (hours):	Actual	Maximum
Last 28 days:	147	**210**
Last week:	51	**70**
That day:	06	**12**

Table Nr 3

1.6 Aircraft

1.6.1 General

The aircraft (*picture nr 4*) was a single engine, low wing and single pilot aircraft, specially prepared for wildfire fighting. Deriving from a previous generation of fire fighters, it was equipped with a water scooping system capable of scooping 820 USG of water in 30 seconds, for what floats had been installed, incorporating a wheeled undercarriage for land operation, becoming more versatile and efficient than his predecessor.

Picture Nr 4

The amphibian aircraft EC-JLB, property of “*Servicios Aéreos Europeos y Tratamientos Agrícolas, S.L.*”, with a Maximum Take-off Mass (MTOM) of 16000lb, holding a valid Airworthiness Certificate issued by Spanish Civil Aviation Authority (DGAC), presented the following technical specifications (*table nr 4*):

Reference	Airframe	Engine	Propeller
Manufacturer:	Air Tractor, Inc.	Pratt & Whitney	Hartzell
Model:	AT-802A	PT6A-67F	HC-B5MA-3D
Serial Nr:	802A-0226	PZE-RZ0063	HBA-1788
Year of manufacture:	2005	-	-
Flight Time (TSN):	315:00	27:35	27:35
Landings / Cycles:	N/D	24	-
Last Inspection Date:	12-04-2012	12-04-2012	12-04-2012

Table Nr 4

1.6.2 Mass & Balance

With an Empty Mass of 9209lb, one pilot (175lb) and 254 gallons of fuel (768lb), when it took-off from Beja, the aircraft had an Actual Take-off Mass (ATOM) of 10152lb. After scooping 500 gallons of water, aircraft actual mass increased to 14325lb, becoming well bellow the MTOM of 16000lb.

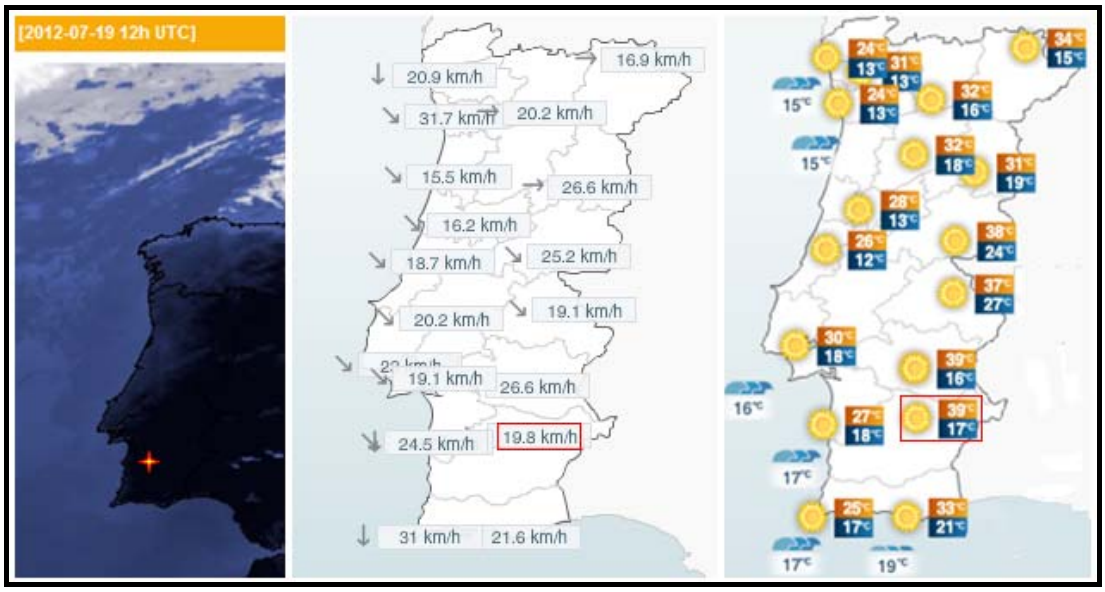
1.6.3 Maintenance

Aircraft airworthiness was granted by operator's own maintenance department (*Martinez Ridao Aviación, S.L.*), certified by Civil Aviation Authority according EASA Part 145 requirements. Last inspection was performed at 287:25 hours, on 12-04-2012, when a new engine was installed (PZE-RZ0063), together with Hartzell propeller (HBA-1788), both with zero time.

Next inspection was programmed to 387:25 and there were no reports of any malfunction or operational restrictions on Technical Log.

1.7 Meteorological

The weather was fine, with clear sky, light to moderate North-westerly wind, high air temperature, capable of reaching 39ºC (*picture nr 5*).



Picture Nr 5

By accident time, the wind was blowing from 310º with 08kt and the temperature was 33ºC, as meteo information from Beja military aerodrome (LPBJ) bellow.

METAR LPBJ 191200Z 31008KT 260V010 CAVOK 33/07 Q1016
METAR LPBJ 191300Z 31009KT 270V340 CAVOK 36/05 Q1015

Over the water, in the "Roxo Dam" lake, it's admissible that the temperature was lower due evaporation effect (probably not more than 30ºC).

1.8 Aids to Navigation

Not applicable.

1.9 Communications

During flight, the aircrafts were in contact with each-other and Air Traffic Control. Inside fire area (operational theatre) they used to keep contact with National Authority for Civil Protection local fire coordinator.

1.10 Accident Site

Roxo Dam is located approximately 10NM Southwest of Beja military aerodrome and, at that time it was at a relatively high water level, which, given the absence of obstacles in its margins, no significant high grounds and no electric power lines in the zone, rendered it favourable for scooping operations. Taking a true heading of 265º (the wind was blowing from 310º), it was possible to draw a virtual runway with 13100ft X 1300ft (*picture nr 6*), well above the needs for this kind of aircraft operations.

Picture Nr 6

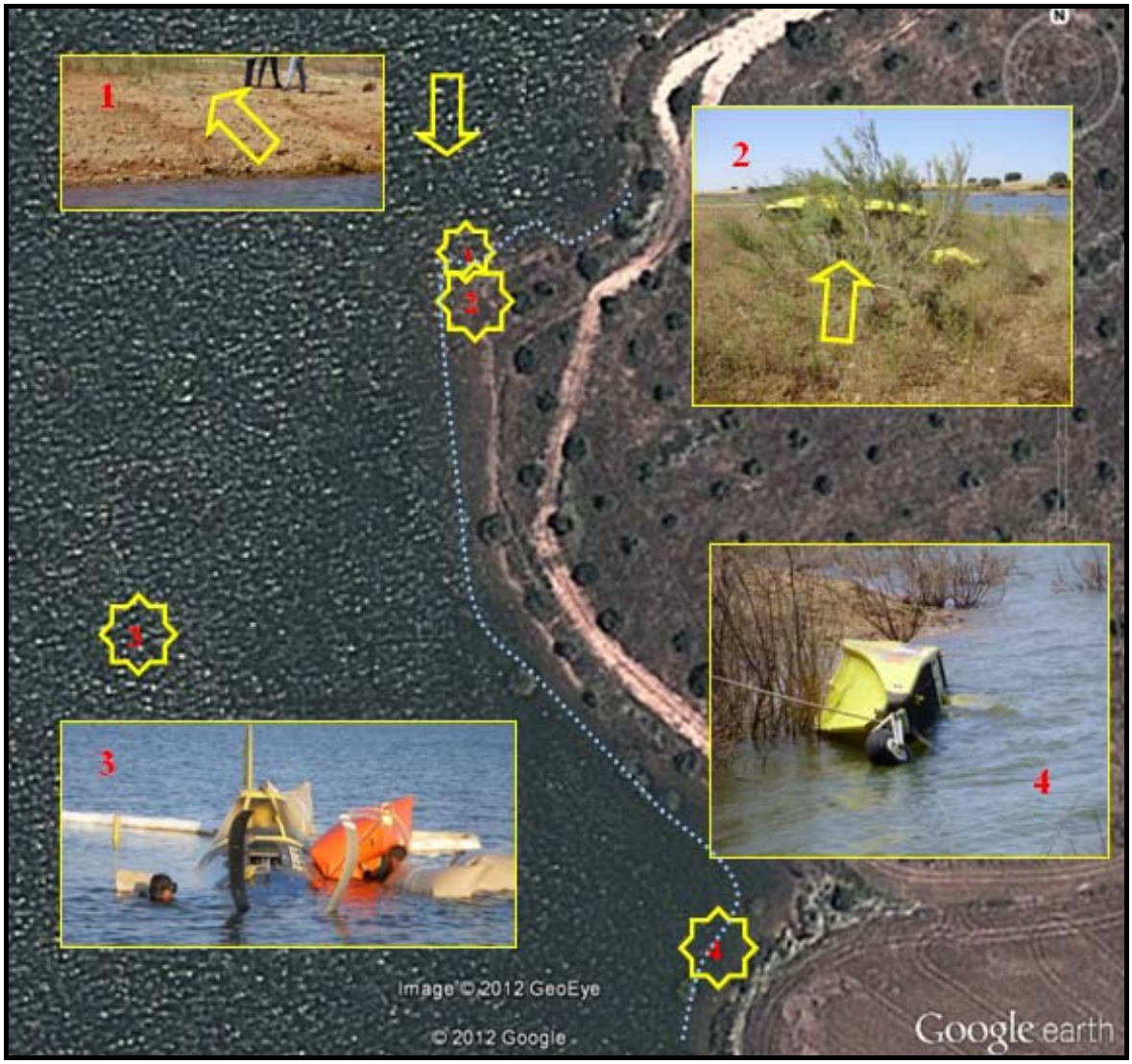
1.11 Flight Recorders

The aircraft was not equipped with any kind of flight recorder, which was not mandatory for this type of aircraft and operation.

1.12 Wreckage & Impact

The aircraft remained complete with only the floats and respective landing gear and water scooping system parts separated.

Picture nr 7, bellow, shows ground impact points and wreckage localization, with the arrows pointing on movement direction.



Picture Nr 7

First impact, with both floats, occurred on lagoon water line (1), which was at a bit lower level than the picture shows (more or less by blue dotting line), on a wings levelled and nose up position. Here the left float separated and rested ashore (2), with the aeroplane flying over the neck of land and impacting the water, nose down, a few metres ahead. Without left float, left wing tip impacted the water and outer wing became damaged, while right float broke apart and drift to its final position (4). The aircraft sunk and was later recovered from the bottom (3).

1.13 Medical & Pathological

The pilot was examined by military doctor and considered fit, without any physical or psychic trauma.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The pilot was secured with a five point's seatbelt, duly adjusted & locked, helmet and safety jacket. After impact he got some trouble disconnecting helmet radio plug and finished by removing it prior to leave the cockpit. Once outside he inflated the safety jacket and swam to the margin. Due the access difficulty he was recovered by a military helicopter and transported to the nearby Air Force Base.

1.16 Tests & Research

No special examination was made to the aircraft wreckage, nor any other tests were conducted, as it was considered they were not relevant for the investigation.

1.17 Organizational & Management

The operator is a certified organization and highly specialized Air Tractor fire fighting and agriculture work operator, conducting his operations in accordance with competent European and National Authorities regulations, which are translated to Company Operations Manual, approved by Spanish Civil Aviation Authority (DGAC).

On part A of that Manual, chapter 8.3.9, some general considerations on dangers related to wake turbulence during take-off and landing are presented and aircraft recommended separation times referred. However, those principles don't apply to group scooping manoeuvres, whose procedures are written on chapter 14.3.3.9, copied bellow:

14.3.3.9 ***Carga con hidroaviones***

a) Geográfico *La operación de hidroaviones en agua exige un estudio geográfico de la zona de agua previo al aterrizaje y carga de agua. El piloto debe sobrevolar la zona de agua y determinar las dimensiones y elevación de la lámina de agua, la dirección e intensidad del viento, las condiciones del agua y oleaje, los obstáculos en la aproximación y en la salida, objetos o materiales flotando en el agua, presencia de bañistas y embarcaciones, y cualquier otro condicionante que pueda influir en las maniobras del hidroavión.*

b) Elección de zona de carga *Completado el estudio geográfico y cuando sea posible la maniobra, el piloto determinará la zona de agua para el aterrizaje, carga de agua y despegue. En operación conjunta de 2 o más aviones, la elección de zona de agua la realizará el piloto con más experiencia que actúa como líder.*

c) Chequeo previo a la carga/ Chequeo cruzado/Configuración *Previo al aterrizaje en agua el piloto realizará la lista de chequeo para la maniobra. El piloto comprobará todos los puntos anotados en la lista sin excepción alguna. Cuando la operación sea conjunta de 2 o más aviones se realizarán chequeos cruzados por radio entre los distintos aviones a modo de CRM, de tal manera que el piloto de un avión leerá la lista de chequeo y el piloto de otro avión la ejecutará para seguidamente invertir las acciones. El piloto líder exigirá que todos los aviones reporten todos los ítems de la lista de chequeo.*

d) Carga múltiple/Coordinación con medios aéreos *La operación en agua conjunta de 2 o más hidroaviones requiere 2 requisitos fundamentales: grandes dimensiones de la zona de agua que permitan la maniobra de un hidroavión detrás del anterior sin recibir estela turbulenta ni oleaje y la coordinación entre las tripulaciones. Se dejará margen de seguridad suficiente para que no exista ningún peligro de colisión ni aun cuando cualquiera aborte la maniobra y pueda quedar detenido en el agua. Los pilotos reportarán el inicio y final de cada fase de la maniobra. El piloto líder vigilará que se cumplen las distancias que garantizan la seguridad. La carga múltiple con hidroaviones de diferente performance será posible solo en zonas de agua de muy grandes dimensiones que permitan crear dos sectores diferentes de zona de carga y las maniobras se realicen en espacios muy separados sin ningún riesgo de colisión.*

1.18 Additional Information

Being the wreckage submerged and the dam providing potable water for several towns and villages in the area, it was necessary to remove it from the lake before it could pollute the waters. For that, all actions and procedures had to be coordinated with relevant authorities.

Civil Protection authorities and other community services showed no availability to provide the necessary equipment and other means for aircraft removal from the water, being the operator requested to recover and remove the aircraft to his premises. The operator contracted a diving and sub-aquatic works enterprise in order to localize, prepare and recover the aircraft from the lagoon.

Works started on next day and continued for another three days, taking account of all necessary measures to minimise and control any fuel or oil spillage, avoiding water contamination, with the oversight of local responsible people from National Water Institute and supported by a specialized team from Sines industrial complex.

After recovery, the aircraft was examined, dismantled and returned to the owner, released by the Investigation Authority.

1.19 Useful or Effective Investigation Techniques

All evidences were obtained in site and retrieved from official documents and no special investigation techniques were used.

2. ANALYSIS

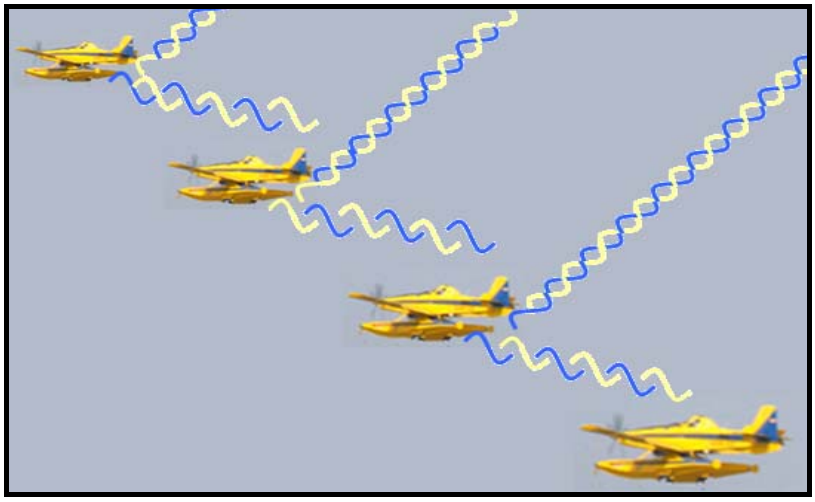
2.1 Flight Preparation

Being fire fighting an unexpected mission, its preparation is done at the very moment it is requested, assuming flight crews are familiar with general operating rules and procedures. So, it is not supposed that some particularly factors had been considered, prior to departure, except aircraft's sequence and their participation in the entire operation.

Usually, this kind of aircrafts operates in teams of two aeroplanes, with the wing positioned behind and to the left of the leader. Being second team wing aircraft, EC-JLB was positioned nr 4, the furthest left rear position.

Considering the lagoon overall dimensions, the absence of significant obstacles in the vicinity and people in and around, the scooping manoeuvre in four aircrafts formation was possible and leader decision was based on these conditions, with the aeroplanes keeping standard spacing, in compliance with Avialsa T-35 Operations Manual (*14.3.3.9* ***Carga com hidroaviones***).

Lateral spacing between aircrafts allowed every aircraft to avoid preceding one (in case of failure and rejected take-off manoeuvre), proceeding in front; while longitudinal spacing kept each aeroplane outside previous aircraft wake, when moving on lake surface (*picture nr 8*).

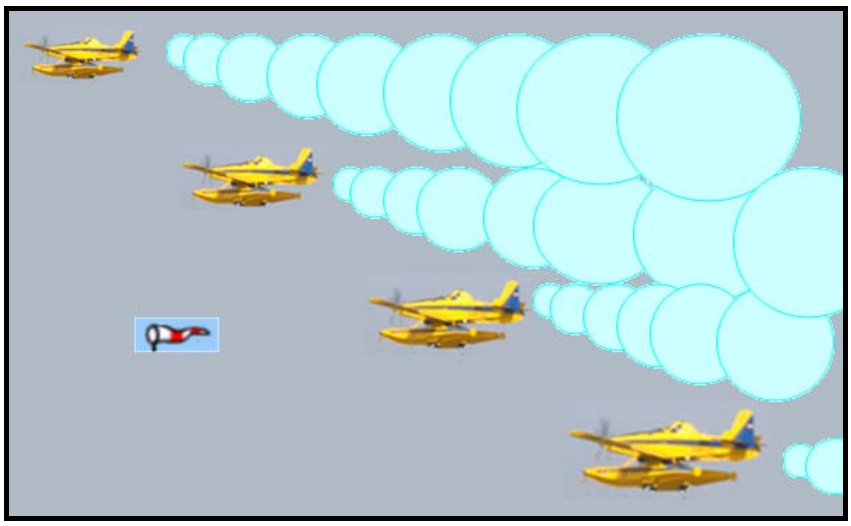


Picture Nr 8

Under normal conditions, this water wake is not significantly affected by wind direction, especially on still waters, like artificial dam or lakes.

Besides this interference of water wake and its propagation, during group water scooping it should be considered the effect of aircraft movement through the air and the wake turbulence generated by it.

In a standard land operating configuration, Air Tractor-802 presents a small transversal section, which generates light wake turbulence. With the introduction of water scooping system and floats, configuring it for an amphibian operating version, its shape becomes enlarged and quite irregular, generating a different kind of wake turbulence, from moderate to heavy, highly penalizing for other small aircrafts flying behind, like it happens during group flying or group scooping.



Picture Nr 9

With the planes heading into the wind, wake turbulence waves propagate straight behind and, due lateral separation between aeroplanes, forward aircraft generated turbulence doesn't interfere with following aircraft, which keeps flying undisturbed (*picture nr 9*).

These considerations should have been taken in mind when group leader decided for a group scooping, considering that the best heading for the manoeuvre (265º) was near 45º to the left of prevailing wind direction (310º).

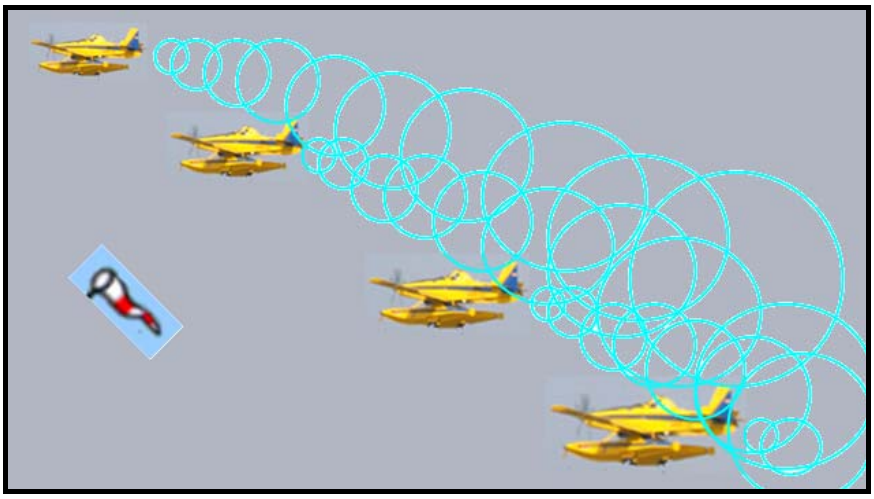
2.2 Flight Progress

After a sequential take-off, by 12:10, the four aeroplanes flew in group towards "Roxo Dam" and proceeded directly for scooping, always in group, on a true heading of 265º approximately, being that the best heading to grant the biggest and widest virtual runway available, more suitable for the group manoeuvre (*picture nr 6*).

Routinely, the four aircrafts positioned on a left line formation, with nr 4 at extreme left rear position and the leader (nr 1) ahead and to the right of virtual runway centre line. Even if available space was fairly used, aircraft nr 4 ditched close to lagoon left margin (*picture nr 2*), which made difficult for him to manoeuvre to the left, just in case.

During water refuelling, the wind was blowing from Northwest with approximately 8kts, making a ± 45º angle with aircrafts' course.

In spite of its low intensity, the wind caused a deviation to the left of wake turbulence waves (*picture nr 10*).



Picture Nr 10

In such a case, wake turbulence generated by preceding aircrafts was interfering with following ones, creating difficulties for its controllability.

If aircrafts 2 and 3 were not too much affected by turbulence and pilots managed to control them without problems, aircraft nr 4 was suffering the influence of all other aircrafts generated turbulence, having its pilot a great difficulty to control the aircraft. In fact, at rotation, after scooping, he lost control of the aircraft and, when he regained it, the aircraft was pointing about 45º to the left, against the margin. He couldn't lift-off before impacting the ground with both floats, lost one of them and crashed a few meters ahead.

If the leader had adopted a right line formation, wake turbulence waves would move outwards of the subsequent aircrafts and the manoeuvre would be facilitated.

2.3 Group Scooping Procedure

Scooping is the most expedite and efficient mean of water replenishment for amphibian and sea planes, consisting of tanks replenishment while performing a touch-and-go on a water surface, instead of landing, taxing to the ramp, shutting-down the engine, refuelling, starting, taxing back to the runway and taking-off. The only need is a sufficiently large water basin (lake, river or artificial dam) to allow the manoeuvre.

On amphibian Air Tractor-802 particular case, a water pumping system was installed, which sucks the water through pipelines on left float, by means of an electric pump, capable of loading 820USG of water in 30 seconds.

Considering that this kind of fire fighting aircrafts use to fly in teams of two aircrafts, each, they may perform water scooping in team, provided water basin dimension permits. For this the planes should guard required safety distances between them, avoiding ditching on water wake from preceding aeroplanes and keeping out of wake turbulence track, having always an escape route available in order to not collide with the other aircraft if it has to reject take-off by any reason.

The operator, AVIALSA T-35, established procedures for this kind of group scooping, written on his Operations Manual (14.3.3.9 d)), but such procedures do not consider the different factors that could negatively interfere with aircraft performance and the recommended practices and procedures to minimize or eliminate those interferences.

3. CONCLUSIONS

3.1 Findings

From what has been referred on previous chapters, the following findings should be enumerated:

1st The aircraft was performing a wild fire fighting mission, integrated in a group of four similar aircrafts, from the same operational base, operating together;

2nd The aircraft had a valid Airworthiness Certificate, complied with approved maintenance programme and had no technical anomalies or any other restrictions registered on its Technical Log;

3rd The pilot was holding a valid Pilot License, which entitled him to fly that type of aircraft and that kind of mission, having no restrictions or limitations that could impaired his operational performance on such conditions;

4th The operation was performed in accordance with principles and regulations established on Company Operations Manual, approved by Civil Aviation Authority, and there was no evidence of any intentional significant deviation from those procedures;

5th All the aircrafts performed a group water replenishment (scooping) operation, keeping established flight formation (in line to the left), on a lake surface suitable for that kind of manoeuvre;

6th During the scooping operation the wind was blowing light to moderate, about 45º from the right of flight track;

7th Just before lift-off, aircraft nr 4 was engulfed by and suffered the influence of wake turbulence waves, generated by preceding aircrafts and deviated to the left by the lateral wind effect;

8th That wake turbulence brought control difficulties to the pilot and cause the aircraft to veer to the left, becoming closer and heading to the lake margin;

9th Before airborne, both aircraft floats impacted the ground on lake margin, the left one separated and rested ashore, but the aircraft flew over a neck of land prior to crash in the water, the other side;

10th The pilot managed to evacuate the aircraft, inflate life jacket and swam to the margin, getting out unhurt;

11th The aircraft suffered substantial damage and sunk.

3.2 Causes of the Accident

3.2.1 Primary Cause

Primary cause of the accident was the temporary loss of control of the aircraft, by the pilot, causing a lateral deviation towards the left margin of the lake, reducing available distance for take-off before the margin being impacted by aircraft floats.

3.2.2 Contributory Factor

The following factors contributed to the accident:

1st Group scooping manoeuvre insufficient planning, without considering the lateral wind negative effect on aircraft performance;

2nd Flying in group, on a line to the left configuration, when the wind was blowing from the right and causing previous aircrafts' wake turbulence waves to move to the left of track and penetrate into following aircrafts' tracking;

3rd Wake turbulence acted directly on last aircraft (nr 4) flight control surfaces, causing a temporary loss of control by the pilot and aircraft heading to the left of initial track.

4. SAFETY RECOMMENDATIONS

Considering that the presence of wake turbulence was the primary factor for the pilot to temporarily lose control of the aircraft and this encounter could be avoided if there was a more careful flight planning, choosing a different type of formation that could keep the aircrafts away from turbulence track, as forced by the wind;

Even if the operator has a dedicate paragraph of his Company Operations Manual (14.3.3.9) where some references are made to the preparation and performance of group scooping manoeuvre;

Recognizing that such information is relatively scarce and do not refer lateral wind effects and recommended actions to deal with it;

It is recommended,

To: **AVIALSA T-35**

"To study the introduction, on his Operations Manual, of more detailed information regarding lateral wind effects on aircraft's performance and control during group scooping manoeuvres, or other similar operations (like simultaneous take-off and landing manoeuvres) suggesting the use of required procedures, namely different formation layout, in order to minimize or avoid such negative effects" (SR 05/2012)

Lisbon, December the 4th, 2012

António A. Alves
(IIC)