HELLENIC REPUBLIC
MINISTRY OF INFRASTRUCTURE AND TRANSPORTATION

HELLENIC AIR AND RAIL SAFETY INVESTIGATION AUTHORITY H.A.R.S.I.A

ACCIDENT INVESTIGATION REPORT OF CESSNA R.182 AIRCRAFT WITH REGISTRATION MARKS 4X-CHZ IN THE SEA AREA OF PYTHAGORION, SAMOS

01 / 2025

ACCIDENT INVESTIGATION REPORT
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Cessna R.182 aircraft with registration marks 4X-CHZ on September 13, 2021 in the Sea Area of Pythagorion Samos

The accident investigation was carried out by the Hellenic Air and Rail Safety Investigation Authority, according to:

- **To Annex 13 of Chicago Convention**
- **Regulation (EU) 996/2010**
- **Law 5014/2023**

"According to Annex 13 of the Convention on International Civil Aviation, Regulation (EU) 996/2010 and Law 5014/23, the aviation accidents and incidents investigation is not intended to assign blame or liability. The sole purpose of the investigation and report is to prevent accidents and incidents.

Consequently, using this report for any purpose other than preventing future accidents could lead to erroneous interpretations."

Hellenic Air and Rail Safety Investigation Authority

Chairman
Georgios Dritsakos

Members

Χρήστος Βάλαρης
Ret. A. F. Brigadier General

Grigorios Flessas
Airline Captain

Secretary: Vasiliki Fouseki

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Abbreviations

Anx.	Annex
ATC	Air Traffic Controller
ATIS	Automatic Terminal Information Service
ATZ	Aerodrome Traffic Zone
CAT	Category
CTR	Control Zone
CVFR	Controlled Visual Flight Rules
DME	Distance Measuring Equipment
E	East
FAF	Final Approach Fix
FH	Flight Hour
FIC	Flight Information Centre
FL	Flight Level
fpm	Feet per Minute
ft	Feet
FWD	Forward
gal	Gallon
h	Hour
HENDO	Hellenic Electricity Distribution Network Operators
hPa	Hecto Pascal
IFR	Instrument Flight Rules
ILS	Instrument Landing System
kt	Knot (Nautical Miles per Hour)
L	Litre
LIH	Light Intensity High
LIM	Light Intensity Medium
MDA	Minimum Descent Altitude
METAR	Aerodrome Routine Meteorological Report
MHz	Megahertz
min	Minute
N	North
NM	Nautical Miles
ºC	Celsius
PAPI	Precision Approach Path Indicator
par.	Paragraph
Rev.	Revision
s	Second
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival (ICAO)
UTC	Universal Time Coordinated
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Radio Range
º	Degrees Magnetic

OWNER	**:**	**PRIVATE**
MANUFACTURER	**:**	**CESSNA**
TYPE	**:**	**R.182**
NATIONALITY	**:**	**ISRAEL**
REGISTRATION MARKS	**:**	**4X-CHZ**
ACCIDENT LOCATION	**:**	**PITHAGORION SEA AREA**
DATE & TIME	**:**	**2021-09-13[1] & 20:01 h**
Note	:	Time is UTC (Local Time = UTC + 3 h)

INTRODUCTION

On 2021-09-13, 10:45 h the aircraft (a/c) type Cessna R.182 with registration marks 4X-CHZ departed from LLHZ airport in the city of Herzliya, Israel, destinating to LLHA airport in the city of Haifa in Israel.

At 12:43 h of the same day, the same a/c, with the Captain and a passenger on board, took off from the LLHA airport destinating to LGSM airport of Samos. During runway 09 VOR/DME approach at the LGSM airport, the Captain reported to the Air Traffic Controller (ATC) that he was at a high altitude and after ATC proposal, he entered the airport's southern circle in order to loose altitude.

During the a/c right turn at the airport southern circle, the aircraft crashed on the sea. The two persons onboard the a/c were fatally injured while the a/c was completely destroyed.

H AAIASB[2] was notified for the a/c accident on 2021-09-13, while on 2021-09-14 the Investigation Team was appointed.

On 2021-09-27 the States of Registration, Operation, Design and Manufacture, the European Commission, the European Aviation Safety Agency, the Civil Aviation Authority and the Hellenic Safety Incident Reporting Committee were notified.

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[1] Dates are indicated in the form: YYYY-MM-DD, time in the form HH:MM:SS

[2] AAIASB existed until 2023-01-20. On 2023-01-21 (Government Gazette 14 A) HARSIA was established, which issued the Accident final report.

The States of Registry, Operation, Design and Manufacture have appointed Accredited Representatives, while the European Aviation Safety Agency has appointed a Technical Advisor.

1 Factual Information

1.1 History of Flight

On 2021-09-13 Cessna R.182 a/c with registration marks 4X-CHZ was scheduled to depart at 09:30 h from Herzliya Airport LLHZ, Israel, on a 00:30 h VFR flight to LLHA Haifa Airport in Israel. At 10:19 h, the Captain submitted a flight plan from LLHA airport to LGSM, with a departure time of 11:00 h of the same day, for a 05:00 h flight duration. Due to an engine oil leak problem, its departure from LLHZ airport was delayed and a new time was assigned for 10:45 h. At 11:11 h the a/c landed at LLHA Haifa airport.

From the LLHA airport security camera footage, at 11:24 h the Captain and the a/c passenger left the airport maneuvering area and headed to the Security Check where at 11:29 h, after its completion, they arrived again at the airport maneuvering area heading towards the a/c.

Based on a report from the LLHA airport, at 11:59 h the Captain requested the a/c departure and was informed that the flight plan had expired half an hour ago and at 12:19 h, he submitted a new flight plan with a departure time of 12:30 h of 2021- 09-13 and destination, incorrectly according to the Captain's statement, the LGRP airport of Rhodes.

At 12:21 h, the Captain was informed that the departure time given was 13:20 h, with the Captain stating that at 13:20 h, he would not take off because he would arrive night at his destination.

At 12:34 h a new flight plan to LGSM airport was submitted. According to it[3], the flight was General Aviation with IFR rules, the scheduled departure was at 12:40 h on 2021-09-13 and its duration was 05:00 h. The flight path of the aircraft based on the flight plan is illustrated in Anx. 5.1, Fig. 2.

At 12:43 h of the same day, the a/c 4X-CHZ with the Captain and one passenger on board, took off from LLHA airport destinating to LGSM airport.

According to the available data and the interviews received, the a/c flight progressed as follows:

[3] 131234 EUCHZMFP
(FPL-4XCHZ2-IG -C182/L-SGY/C -LLHA1240 -N0120F050 DCT GALIM P68 ZAHAV/N0150F080 P68 MERVA DCT VELOX M42 ALKIS G18 RDS L995 KOPAR H59 LARKI -LGSM0500 LGSM -DOF/210913 ORGN/LLADZPZX

• The Captain's communication with TelAviv Air Traffic Control was uneventful, with the Captain performing correctly the readback of the instructions he received from Air Traffic Control.

• The a/c was cleared from Rhodes Airport approach to climb to Flight Level 120 (FL 120).

• At 16:34:44 h at FL 121 with ground speed of 140 kt, the a/c initiated the right turn to LARKI, while at 16:46:04 h the a/c executed another right turn to the LARKI point, via the runway H59.

• At 16:47:45 h, the aircraft was authorized by FIC to descent to FL70, Anx. 5.2, Fig.1.

• The a/c made first contact with Samos airport Air Traffic Controller (ATC) at 16:49:13 h, Anx. 5.2, Fig.1 and at 16:49:53 h was authorized to proceed to the LARKI point and descend to 4000 ft with QNH 1008 hPa. At 16:50:06 h, the Captain confirmed the authorization.

• At 16:50:43 h the Captain was asked by the ATC whether he has received the information from ATIS (Automatic Terminal Information Service), without answering from the Captain.

• The a/c at 16:50:34 h was at 8000 ft with a ground speed of 140 kt, Anx. 5.2, Fig. 1 and at 16:50:54 h was authorized by the ATC for a VOR/DME approach to runway 09, commencing from LARKI point. The specific authorization was repeated by ATC at 16:51:16 h and the Captain reported: *"Roger VOR ee approach commencing from ee LARKI, CHZ".*

• At 16:51:45 h, the Captain reported: *"CHZ, I request eee the VOR ee approach"*. The ATC confirmed to the Captain that he has an approved authorization for a VOR/DME approach to runway 09 and described the approach procedure. The a/c Captain said: "Roger".

• At 16:52:33h the ATC asked the Captain to report over LARKI with the Captain responding at 16:53:07 h that he was still at 7000 ft and was again instructed by the ATC to descend to 4000 ft, Anx. 5.2, Fig.2. According to the published AIP VOR / DME approach procedure, the prescribed minimum altitude at the LARKI point was 4000 ft, Anx. 5.6, Fig.5.

• The ATC at 16:55:08 h authorized the a/c Captain to descend after LARKI to 3000 ft, describing him the execution of the procedure. The Captain responded: *"After LARKI ……..and eee a right turn you said?"* with ATC responding: *"Yes to establish radial one seven eight inbound Sierra Alfa Mike VOR".*

• The Captain, at 16:58:21 h reported a distance from Samos of 8.5 NM and then the ATC authorized him to descend to 1800 ft and to inform the ATC when the airport was in sight. The

ATC stated in an interview that he could see the a/c lights, the a/c was in the correct position and proceeded to the VOR/DME as per procedure.

• The Captain then responded: *"Roger descending to ee eight hund..., eight hund..., eight thousand eight hundred feet"*. The ATC repeated twice to the Captain the height of 1800 ft and to report when he has the runway lights in sight.

• At 16:59:06 the Captain, following a question from the ATC, stated that he did not have the runway in sight.

• At 17:01:14 h, the ATC asked the Captain to state the distance from Samos and the Captain stated: *"CHZ dist.. eee, distance two point six and eee..."*, Anx. 5.3, Fig.3 . The ATC asked the Captain to confirm if he has the runway in sight, with the Captain replying: *"Roger, we' v eee green and red light"*. The estimated altitude by ATC at 2.6 NM was 2000 ft - 2500 ft.

• The ATC repeats the question if he has the runway in sight with the Captain responding: *"...eee, airport in sight"*.

• The ATC, at 17:02:12 h, asks the Captain to confirm if he can continue the landing on runway 09, with the Captain replying: *"Yes but I am still very high"*.

• The ATC, at 17:02:19 h, proposes to the Captain: *"....you may continue, if you wish over the runway, then right turn, come again to the south and make a circling to loose altitude"*, with Captain accepting the controller's proposal. In his interview, the ATC stated that the height in the airport circle for small airplanes was 1000 ft[4].

• The Captain flying over the SAMOS VOR, following the instruction of the ATC, made a right turn and flew parallel to the runway and a slightly north of the airport control tower. The ATC made visual contact with the aircraft lights and heard the engine sound, without noticing any malfunction.

• At 17:03:00 h the Captain, without declaring any problem, reported over the runway, with the ATC informing him, that he had him in sight. In Anx. 5.3, Fig. 4, it is shown the estimated position where the Captain reported over the runway.

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[4] In AIP AD 1.1, par. 1.1.6.1.2.1, is stated:
"If no instructed otherwise by the Aerodrome Control Tower, light aircraft approaching an aerodrome in compliance with VFR, will enter the traffic circuit at a height of 1000 ft or below when unable to comply with VFR at this height".

• The a/c over runway 27 threshold, was in a climbing phase and made a slight right turn, flying south. An increase in engine speed was also heard during climb.

• The a/c, having overflown the runway, located southeast of the control tower and flying south-southwest, the ATC discerned the steady red light on the a/c, which had a descending path with a high rate of descent, while he was expecting to see the green light and made the first call to the a/c at 17:03:46 h. The estimated height of the a/c, according to the ATC, was 1500 ft.

• The ATC made a call to the a/c at 17:04:12 h, when the a/c red light was no longer visible, with the last call made at 17:04:19 h.

• At 17:04:27 h, the ATC calls the Follow me and reports the a/c crash into the sea.

• In the interviews conducted, it was reported that the a/c descent was at a high vertical speed, its engine was heard with no signs of malfunction and no fire or explosion was observed in the a/c.

• In the available transcripts, the Captain did not report a technical problem or a/c a fuel starvation.

• From the ATC interview, it was mentioned that there was darkness in the airport area. Also, it was not possible to distinguish the a/c but only its lights, while the Captain did not mention that he was encountering any problem.

After the a/c crash into the sea at approximately 17:04:12 h in night conditions (Anx. 5.9, Photo 11), a nearby fishing vessel went to the point of impact and its Captain informed the coast guard about the a/c crash, at a distance of five stages south of the airport at a estimated coordinates of 37° 40' 22" N and 26° 54' 30" E.

Sunset time on the day of the accident at Samos airport was 16:23 h. The phase of the moon was in the first quarter, its projection on the horizon of the accident area was in the south, southwest direction and its sunrise - sunset time[5] was 13:59 h and 23:38 h.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	1	1	0
Serious	0	0	0
Minor/None	0/0	0	0

[5] Local time

1.3 Damage to Aircraft

From the a/c recovered wreckage, it was found that the a/c was completely destroyed.

1.4 Other Damage

Following the a/c crash into the sea, sea pollution examination was performed from the coast guard, with negative results.

1.5 Personnel Information

1.5.1 Captain

The a/c Captain was 69 years old and held the following certifications:

License:	PPL issue date 2020-12-03.
Type ratings	• Airplane Single – Engine Land. • Instrument Airplanes. • Night CVFR Rating.
Medical certificate	• Class II. • With restriction to wear corrective glasses/lenses. • Examination date :2020-12-27. • Valid up to 2022-02-03.
English language certificate	Level 5 expiration date 2024-10-15.

According to the available information:

- On 2020-10-20 was successfully assessed in “Pilot Periodical Recurrent Check”.
- On 2020-11-30 was assessed in Night CVFR Rating and it was valid for six (6) months.
- The Instrument Rating had expiration date on 2021-09-16.
- After 2020-11-30 and up to 2021-7-30, no other flight of the Captain with an instructor is recorded.
- According to Israel's Aviation Regulation, the pilot license has no expiration date. A pilot is allowed to exercise his privileges if within 24 months before the flight, he has passed a periodic flight test.

1.5.2 Flight Experience

According to Pilot’s Logbook:

- Up to 2021-7-30 (date of the last pilot logbook entry), he had totally 672.7 h.
- Had never flown before to Samos Airport.
- In the last 24 h, 7 και 90 days, he had flown:

24 hours	0.0 h
7 days	0.0 h
90 days	9.3 h

- His last flights in different conditions were:

Conditions	Date	Duration (h)
Day	2021-7-30	2.5
Instrument	2021-6-20	2.6
Night	2021-3-09	0.9

- From 2020-12-03 up to 2021-07-30, the Captain had:

Conditions	Total flight hours (h)
Day	39.3
Instrument	26.5
Night	0.9

1.5.3 Captain's Certification

The Captain's Instrument Rating certification assessments were the following:

Examination Date	Subject described in the examination form	Revision of the Examination form	Examination Results
2020-05-13	*Instrument Rating Skill Test & Proficiency Test*	Rev.1- 10.01.2019	Unsatisfactory
2020-07-21	*Pilot Instrument Qualification or Proficiency FLT Check*	Rev.1- 01 May 11	Unsatisfactory
2020-09-16	*Pilot Instrument Qualification or Proficiency FLT Check*	Rev.1- 01 May 11	Satisfactory

Table 1: Review of Captain's assessments for Instrument rating certification

According to HARSIA available data:

• The difference between the two examination forms revisions is that the "Approaches (C)" field of the revised form refers to a single engine, while the corresponding field of the form with an old revision number, which was not in force, refers to multi-engine touch. Also, in the "Oral

Discussion" field of the revised form there are two additional fields compared to the non-revised one and in the "Air Work" field, there is correspondingly one less.

• It is the policy of the Civil Aviation Authority (CAA) of Israel not to provide the results of previous assessments to the next assessor.

• It is not required to carry out the assessment of both SID, STAR procedures (the assessment of one of the two procedures is sufficient).

From the forms used in the three Captain's assessments, it was observed:

• In the first assessment, 12 of the 45 exercises of the form were assessed. In all 12 exercises the result was unsatisfactory.

• Out of 12 assessor's comments after the unsatisfactory first assessment, among others were:

- Lack of situational awareness (SA),
- Shallow climb in all phases of the flight and execution of shallow Go Around, failing to acquire the right gradient.

• Three (3) exercises that were not assessed satisfactory in the first assessment, were recorded as not applicable in the second assessment. Among them is the exercise "Best Rate or Best Angle Climb speeds" (Rev.1- 10.01.2019) and "Best Rete of Climb speed" (Rev.1- 01 May 11).

• One (1) exercise in the "Holdings" field, which was not assessed in the first assessment, was assessed unsatisfactory in the second while in the third assessment it was recorded as not applicable.

• Two (2) exercises from the field *"Approaches (STAR's and ILS CAT1 Approaches)"* and two (2) exercises from the field *"Intercepting and Tracking Procedures"* which had not been assessed satisfactory or had not been assessed at all in the first assessment, in second and third assessments they were recorded as not applicable.

1.6 Aircraft Information

1.6.1 General Information

Aircraft Manufacturer	CESSNA
Model	R.182
Serial Number	R182-00161
Year of Manufacture	1978

Registration	4X-CHZ
Total Flight Hours (on 2021-03-16)	2963.2 h
Airworthiness Certificate	Issue : 22.03.2021 Valid up to : 21.03.2022
Certificate of Registration	Issue : 30.10.2019
Radio License	Issue : 23.10.2019 Valid up to : 31.12.2021

Engine

Manufacturer	LYCOMING
Type	O – 540 - J3C5D
Number Installed	1
Serial Number	L – 19556 - 40 A
Flight Hours (on 2021-03-16)	891.1 h since overhaul.

Propeller

Manufacturer	McCauley
Type	B2D34C214-B
Number Installed	1
Serial Number	794396
Flight hours (on 2021-03-16)	258.6 h since overhaul.

According to Maintenance Organization data, on 2021-09-14 the flight hours were: 2963.2 h for the a/c, 891.1 h for the engine and 258.6 h for the propeller.

According to the Captain's logbook, from 2021-03-22 up to 2021-07-30, the Captain had performed 12 flights with the accident a/c, accumulating 26.5 h, but it is unknown if any other flights were performed with other Captains.

From the available data, in the a/c registration country, there is no insurance requirement for private operating airplanes, but only for commercial operating airplanes.

1.6.2 Aircraft Maintenance

On 2021-03-16 the last recorded inspection of 200 h was certified. According to the a/c Service Manual 2-57 c (2) (b), its complete inspection includes the inspections of: 50 h, 100 h, 200 h, special and annual inspections.

1.6.3 Aircraft Fuel

On 2021-09-13, the a/c was refueled, at Haifa City Airport LLHA, with 36 L 100 LL fuel and carried extended range fuel tanks with a total capacity of 80 US gal and a total usable capacity of 75 US gal.

1.6.4 Aircraft Weight

According to the a/c records, the maximum takeoff weight was 1406 kg (3100 lbs).

1.6.5 Aircraft Lights

The navigation lights are located on the two wing tips (red on the left and green on the right), while the flashing beacon light is located on the vertical fixed tip.

1.6.6 Aircraft Auto Pilot

The a/c was equipped with an automatic pilot system, S-TEC type SYS 50 PROG, two axes, roll and pitch.

In the autopilot operating manual, it is stated:

• The roll axis had the functions[6]: Stabilizer (STB) Mode, Heading (HDG) Mode (optional), Navigation (NAV) Mode, Approach (APR) Mode, Reverse (REV) Mode and the pitch axis[7], featured the Altitude Hold (ALT HOLD) Mode.

• Altitude Hold (ALT HOLD) Mode can only be engaged if Roll Mode (STB, HDG, NAV, APR, REV) is already engaged.

1.6.7 Aircraft Maneuvering Limits

The a/c was certified as “Normal Category”. According to this certification, among other things, closed turns where the bank angle does not exceed 60° are allowed.

1.7 Meteorological Information

According to METAR issued at 16:50 h, the wind at the LGSM airport had a speed of 03 kt from a direction of 210°, while the cloud, ceiling and visibility conditions are described as CAVOK[8].

Samos Airport METAR (LGSM): 131650Z 21003 KT CAVOK 25/17 Q1008=

In Anx. 5.12, Tab. 3, VMC conditions minimum limits are reported.

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[6] Stabilizer (STB) Mode: Hold Wings Level, Heading (HDG) Mode: Turn onto a Selected Heading and Hold it, Navigation (NAV) Mode: Track a VOR Course, Approach (APR) Mode**:** Track a LOC Course, Reverse (REV) Mode: Track a LOC Back Course.

[7] Altitude Hold (ALT HOLD) Mode: Hold Altitude.

[8] CAVOK: cloud, ceiling and visibility are OK

1.8 Aids to Navigation

For the LGSM airport approach, the VOR/DME procedure was used. The LGSM aerodrome was equipped with a VOR/DME radio aid which had the characteristic code SAM, transmitted on the frequency 111.60 MHz, was in 24 hour operation and had coverage up to FL 200 and at a distance of 25NM.

It was also equipped with an NDB radio having characteristic code SMO, transmitting on the frequency 375 kHz, operating 24 hours a day and having a coverage of 80 NM. On the day of the accident, a NOTAM was in effect for LGSM Airport:

(B0963/21 NOTAMR B0799/21

Q) LGGG/QNBAS/IV/ BO/AE /000/999/3741N02654E005

A) LGSM

B) 2107232053

C) 2109252359

E) SAMOS NDB SMO 375 KHZ U/S.)

1.9 Communications

The a/c communication with the FIC and Samos airport ATC was carried out satisfactorily.

An audio copy of the pilot's communication with FIC and ATC as well as a copy of the transcript of the respective communications were available during the Investigation.

1.10 Samos Airport

Samos Airport (LGSM) has coordinates 37º 41' 21.0" N, 026º 54'44.0" E, altitude 5.74 m (18.83 ft) and is 5.5 NM from the city of Samos. It has runway (RWY) 09/27 with dimensions of 2044 x 45 m.

Among other things, runway 09 is equipped with a length of 420 m simple approach lights, green on the threshold, PAPI[9], red runway end lights. The AIP[10] (AIRAC AMDT 07/21 Effective Date 09 SEP 2021), part AD 2-LGSM-ADC states that the runway edge lights are medium intensity (LIM), while AD part 2.14 states that the runway edge lights are high intensity white (LIH). Also, in the LGSM AD 2.17 ATS AIRSPACE table, the ATZ and CTR areas of Samos airport were designated as class D.

[9] PAPI: Precision Approach Path Indicator.

[10] AIP: Aeronautical Information Publication.

According to information available from the airport operator, on 2021-09-13 the runway edge lights were medium intensity (LIM) and in November 2022, they were changed to high intensity (LIH) and then the AIP was revised.

According to NOTAMs that were in force on 2021-09-13 for Samos Airport, among others the following were in force:

• From 2021-06-24, 09:17 h to 2021-10-30, 20:00 h, the Airport operating schedule was daily with 24 hours of operation per day.

In the interviews conducted, it was stated that all airport lights were ON, while the Airport was open 24 hours a day and there were no passenger flights at night.

In Anx. 5.6, Fig. 5, the AIP-described VOR/DME instrument approach procedure to Samos Airport (LGSM) is illustrated, starting from the LARKI point with a minimum altitude of 4000 ft. It also mentions a "Circling South of RWY" approach with the Minimum Descent Altitude (MDA) after the FAF (Final Approach Fix), for the a/c category, 1750 ft while no authorization is given for a straight approach (Straight – in Approach: Not Authorized).

1.11 Flight Recorders

A memory card and a mobile phone were recovered from the a/c wreckage. Both were sent to the Directorate of Criminal Investigations (DCI) of the Hellenic Police for laboratory examination, for possible data recording. According to the DCI report, the laboratory examination of the above evidence devices was not possible due to their extensive damage and corrosion from liquid.

1.11.1 Aircraft Flight Recording by Radar System

From the a/c flight playback and the recorded course transcription, the following emerged:

• The a/c was at LARKI point at 16:54:23 h, at FL 63 and ground speed 140 kt, Anx. 5.2, Fig.2.

• At 16:54:33 h was the last a/c recorded position, which was after the LARKI point at FL 63 with a ground speed of 139 kt, Anx. 5.2, Fig.2.

• After the last recorded position at 16:54:33 h until the time the a/c crashed on the sea, there was no recorded a/c position by the Radar system, since in this particular area the Radars cannot reveal a target at a low height due to shadows.

1.12 Wreckage and Impact Information

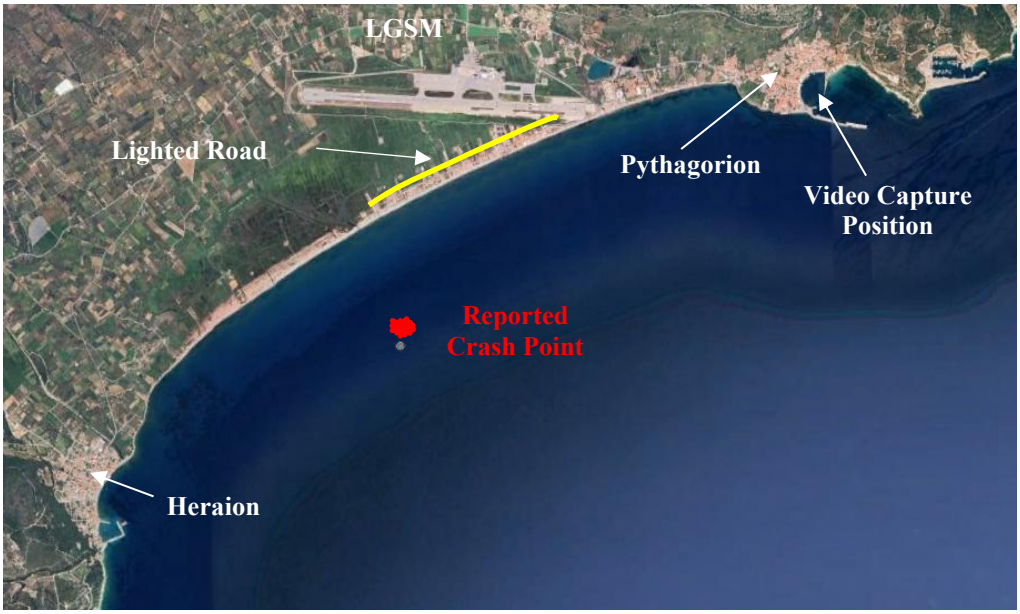
1.12.1 Accident Site Description

The accident site is located in the sea area south of Samos Airport, between the areas of Heraion and Pythagorion. From the interview of the fishing vessel Captain, that went to the place where the a/c crashed, the depth of the sea is 32 m and it is 0.7 NM from the shore.

For a distance of 1.5 km from the beginning of RWY 27, there was a coastal lighted road, which consisted of HENDO columns in a total length of 850 m and municipal lighting with 2 m lantern-type lamps at a distance of 650 m, Fig.1.

From the available data, it emerges that on the accident date, the municipal lighting was in operation, while there was no recorded failure report for the lighting under the responsibility of HENDO.

In Anx. 5.10, Photo 12 and Photo 13, Samos airport is depicted in a night flight environment.



Picture 1: The Accident Site.

1.12.2 Aircraft Crash

The last 14 s of the a/c flight were captured on video footage by a camera on a floating vessel stationed in the port of Pythagorion (Picture 1). The video material has a total duration of 39 s, while the a/c crash in the sea takes place at 34 s.

At 29 s of the video footage, a snapshot has been isolated which depicts the a/c being in flight above the sea with a southerly course, Anx. 5.4, Photos 5,6.

At 31 s of the video footage, two snapshots have been isolated. In the first one, the a/c is depicted in a right turn, having roll angle of approximately 90° and in the next one, the a/c maintains its right roll angle and has acquired a negative pitch angle (Pitch Down), Anx. 5.4, Photos 7, 8.

At 33 s of the video material, a snapshot has been isolated which shows the a/c 1 s before crashing on the sea, being in a right roll of about 90°, Anx. 5.4, Photos 9, 10.

1.12.3 Aircraft Finding Search

1.12.3.1 Initial Aircraft Finding Search

After the a/c crash on the sea and the arrival of the floating vessels as mentioned in par. 1.15, Samos Port Authority was informed that at 20:30 h, wreckage of the a/c was found at position 37° 40' 24" N and 026° 55' 22' E.

At 22:10 h, the Underwater Missions Unit carried out an underwater search at the point 37º 40' 24" S and 026º 55' 22" E and around it, aiming to find the a/c as well as trapped persons, with negative results. The debris found during the initial investigation at the accident site, were recovered by floating vessels and transported to a hangar for safekeeping (Photos 1, 2).

Among other things, the two front seats and the rear seat of the a/c cabin as well as the nose wheel were recovered.

Photo 1, Photo 2: The a/c recovered wreckage after the initial accident site search.

1.12.3.2 Aircraft Location and Recovery Search from a Hydrographic Vessel

On 2022-01-20, a search for the a/c location and recovery initiated, with the participation of a hydrographic vessel and a team of divers. Teledyne Reson SeaBAt 7125 Dual Frequency multi-beam Sonar was used during the search, the sea depth ranged from 5.5 m to 45.0 m and the total search area was 8.2 km^2, (Anx. 5.5, Fig. 3,4).

From the carried-out search, neither the a/c nor its parts were located and on 2022-01-27 the search was terminated.

1.12.3.3 Aircraft Wreckage Recovery from Fishing Boat

On 2022-02-27, part of the a/c wreckage was found and recovered by a fishing boat and was taken for safekeeping in a sheltered area. Among the wreckage were:

• The left a/c entrance door.

• The left side Wing Strut.

• Part of the left and right cockpit instrument panel, together with the two control wheels as well as flight instruments.

• Left and Right Pedal Bars, as well as the brake links.

1.12.4 Wreckage Examination

Detailed description of the findings is provided in Anx. 5.13. In addition to Anx. 5.13 findings, it was determined:

• The left yoke was fractured on its right side, Photo 3. The right hand yoke was fractured in its left and right side, Anx. 5.11, Photo 15.

• The cockpit instrument panel was broken in the center section and outboard of the right yoke.

• The available circuit breakers located on the left instrument panel had not been activated.

• The flaps control lever was in the up position and, together with the cabin heating and cabin air levers, were bend to the right, Anx. 5.11, Photo 16.

• The left and right rudder pedal bars were bent backwards, Anx. 5.11, Photo 17.

• In the left position, the rudder pedals are not fractured.

• The right seat rudder pedals are fractured. The fracture surface of the left rudder pedal is consistent with right bending, while for the right rudder pedal it is consistent with forward bending. Among the right position brake links, the left one had been twisted to the right, while the right one had been bent forward, Anx. 5.11, Photo 18.

• The arrangement of the two yokes and the elevator torque tube was reconstructed, according to the instructions of the a/c Service/Parts Information.

From the macroscopic examination it was observed that the two yokes were in the left roll position, Photo. 3. The mounting points of the two push-pull rods on the two control wheel tubes have been twisted to the right (Anx. 5.11, Photos 19, 20), while the elevator torque tube was bent, consistent with the compression load applied to the tube, as a result of the impact, Photo 3.

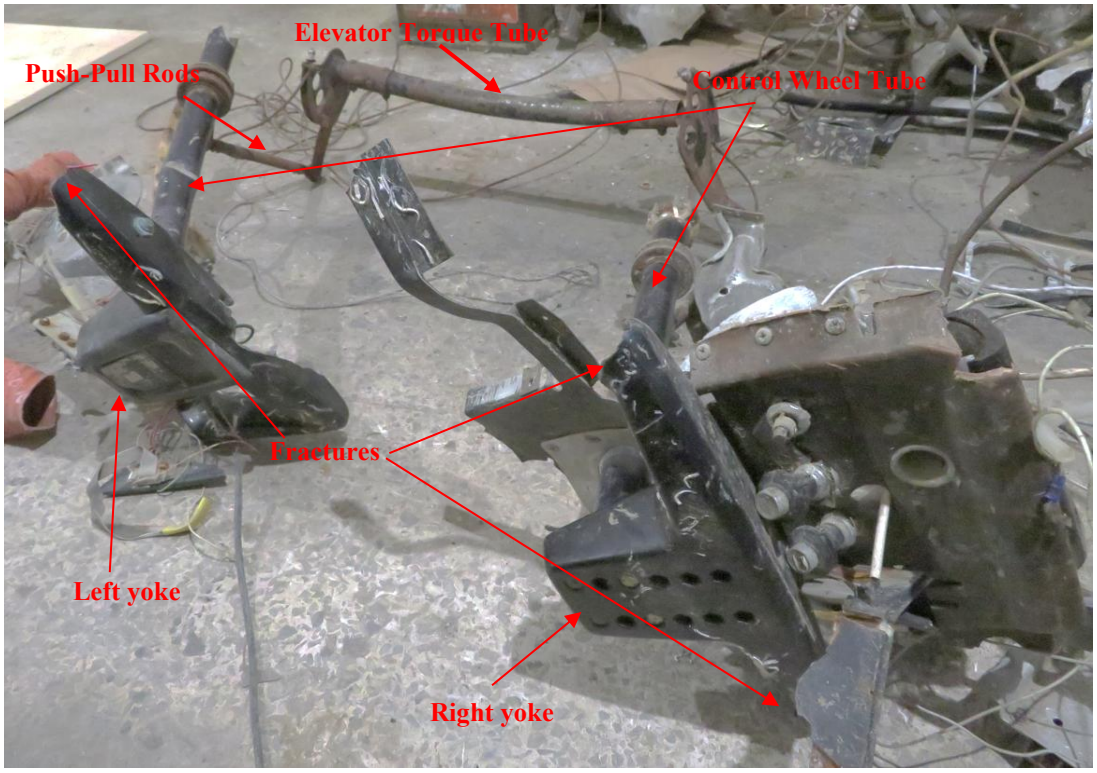


Photo 3: Controls arrangement reconstruction.

1.13 Medical Information

A Forensic examination was carried out on the two persons on board the a/c, while a toxicological examination was carried out on the Captain for the detection of alcohol, drugs and substances, with negative results. A toxicology test was not performed on the a/c passenger.

From the results of the Captain's Forensic examination, the injuries are indicative of the forward and right position in the a/c and its attitude during the crash.

In particular, fractures were found on the right leg of the Captain, consistent with the impact energy having the foot on the right rudder pedal and the fracture direction of the right rudder pedal of the forward right seat. Multiple crushing fractures were also observed, among others, on most sides of the hemi thoraxes with a degree of displacement of the bony pieces of the ribs, right inward and left outward.

Both occupants had injuries consistent with the a/c attitude during the crash and the severity of the crash.

1.14 Fire

Not applicable.

1.15 Survival Aspects

Following the a/c crash in the sea and the notification of the Samos Port Authority by a fishing boat, the local emergency plan was implemented and the Coast Guard vessels and on the order of the Port Authority, Frontex vessels, nine (09) private boats and divers went to the accident site.

The Coast Guard was informed that at 20:40 h local, the bodies of the two persons on board the a/c were found and recovered.

At 22:18 h local it was confirmed by the Samos airport that there were two (02) persons on board the a/c and subsequently, given that the two bodies were found, the boats were ordered to leave.

At 23:26 h local two more boats departed from the search area while one remained to continue searching and debris recovering.

1.16 Tests and Research

In the context of the accident Investigation, a simulation was carried out in a flight simulator, based on the lighting and weather conditions during the a/c approach, of the VOR/DME approach procedure, starting at LARKI and also of the estimated course (Anx. 5.3, Fig. 3 and Fig. 4) of the a/c after the VOR/DME and until its crash.

The simulation started at LARKI point at an altitude of 6000 ft (6300 ft the accident altitude) and descending at 500 ft/min with ground speed of 130 kt, the predicted approach path was followed. At 2.8 NM from the SAM VOR/DME, the simulator's altitude was 2770 ft, it was scheduled to stop at four different altitudes[11], and a runway visual reconnaissance was conducted.

From the visual reconnaissance, it was observed that at all four different heights, were visible: the runway edge lights (as the height was reduced, the runway edge lights became less distinct compared to the apron flood lights), the red lights at the end of runways 09 and 27, the apron flood lights and the control tower beacon green light.

[11] 1800 ft, 2000 ft, 2500 ft, 2770 ft, MSL

Photo 4: The LGSM lights visible at 2.8 NM from the SAM VOR/DME at an altitude of 2770 ft in the flight simulator.

1.17 Organizational and Management Information

The Israel Civil Aviation Authority's procedures regarding the practical examination in aeroplanes and helicopters state that examiners should examine all flight subjects and exercises.

1.18 Additional Information

1.18.1 CAVOK

When the term CAVOK is used in METAR, the following criteria must be met[12]:

- Visibility must be 10 km or more.
- No clouds below 5000 ft or below the highest MSA (Minimum Sector Altitude), whichever is greater.
- No storm clouds (CB).
- No significant weather.

1.18.2 Flight Plan Submission

- According to ICAO Doc 4444, 4.4.2.1.3: *"In the event of a delay of 30 minutes in excess of the estimated off-block time for a controlled flight or a delay of one hour for an uncontrolled flight for which a flight plan has been submitted, the flight plan should be amended or a new flight plan submitted and the old flight plan cancelled, whichever is applicable.".*
- *"Controlled flight: Any flight subject to clearance by air traffic control".*

1.18.3 Visual Approach

In AIP 1.3.12, par. 1.3.12.1, it is stated for the visual Approach:

"An instrument flight rules (IFR) aircraft may be cleared to execute a visual approach upon request of the pilot or if initiated by the controller and accepted by the pilot."

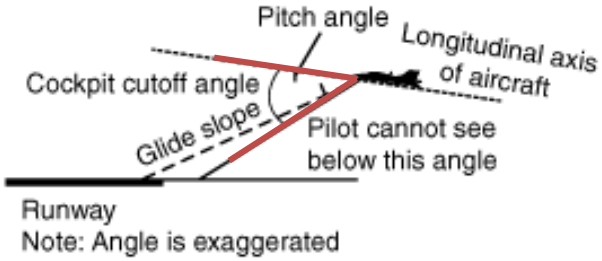
[12] FAA Aviation Weather Handbook

1.18.4 Definition of Night

In AIP Part 2, ENR 1.2.4.7.1, it is stated: "*Night is considered the period 30 minutes after sunset until 30 minutes before sunrise".*

1.18.5 Cockpit cut-off angle

The angle between the longitudinal axis of the aircraft fuselage and an incline plane below up to the limit at which the pilot can view.



1.18.6 Aircraft Overbanking Tendency[13]

During the a/c turn, the outer wing travels at a higher air speed than the inner wing, resulting in greater lift. This, at a bank angle of approximately 45° or more, even with the controls in neutral position, creates an a/c overbanking tendency which must be controlled by using opposite roll control when the desired bank angle is reached, to prevent the a/c overbanking.

1.19 Useful or Effective Investigation Techniques

Not applicable.

[13] FAA Airplane Flying Handbook

2 Analysis

2.1 Aircraft Flight from LLHZ Airport to LLHA Airport

As certified by examination of his records, the Captain prior the a/c departure from LLHZ airport had all his certificates in force, except for his Night CVFR rating which had expired as of 2021-05-30. From the a/c records, it is certified that the a/c had conducted its last full inspection while its certificates were valid.

The problem of the a/c oil leak prior to departure from LLHZ airport, although did not contribute to the accident, delayed the a/c departure by 01:15 h resulting in its arrival at LLHA airport, 00:11 h after its initial scheduled departure at 11:00 h.

2.2 Aircraft Flight from LLHA Airport to LGSM Airport

At 11:59 h, when the Captain asked the departure of the a/c, the initial departure delay had exceeded 00:30 h and according to the provisions of par. 1.18.2, the flight plan had expired as of 11:30 h. The Captain's Night CVFR certification expiration on 2021-05-30 did not affect the conduct of the accident flight under IFR rules.

Following the submission of the second flight plan to the LGRP, the captain's refusal to take off at 13:20 h is consistent with his lack of proficiency in night flight environment, given his short total number of flight hours (0.9 h) since the issuance of his certificate and the 6 months and 4 days time lapse since his last night flight (2021-03-09).

Despite the fact that the Captain refused to depart at 13:20 h due to the expected night arrival at his destination, he decided to take off at 12:43 h for the accident flight even though, according to the flight plan, he would have arrived at Samos airport at 17:40 h, 01:17 h after sunset at the airport. From the available data, it could not be justified why the captain did not cancel his departure at 12:43 h, but the possibility that the arrival time at Samos was not correctly calculated in relation to the ambient lighting conditions at LGSM could not be excluded.

After the first contact with the LGSM ATC and the command to descend the a/c at 4000 ft, from the a/c flight data at 16:50:34 h and above LARKI[14] at 16:54:23 h, it was calculated that a descent was made at an average rate of descent of 450 ft/min, instead of an average rate of descent of 1059 ft/min which would provide the authorized altitude of 4000 ft at LARKI.

[14] Distance between the two points 8.81 NM

As there was no recording of the a/c track by the radar system after 16:54:33 h until its crash, it cannot be known whether the a/c descent was performed in accordance with the described procedure in the AIP.

From the transcript review of the conversations between ATC and the Captain, it is determined that in the period from the Captain's first contact with ATC (16:49:13 h) to 16:50:06 h, the Captain performed the readback immediately and in a correct manner.

As revealed by the review of the conversations, from 16:50:43 h to 16:55:42 h ATC repeatedly described in detail the VOR/DME approach procedure to the Captain. During the same period, the Captain, possibly was informed of the approach procedure by the relevant charts and the lack of a second crew member deprived him of the possibility of task sharing.

The combination of the above factors increased the workload of the Captain and caused him to be distracted and not concentrate on understanding the ATC instructions, as evidenced by the fact that the Captain was requesting the re-confirmation of part of the ATC instructions and the re-approval of the approach clearance. At the same time the confirmation of the instructions (readback) to ATC, contrary to the a/c departure from LLHA and the time interval from 16:49:13 h to 16:50:06 h, was incomplete or not carried out.

The Captain's increased workload, combined with distraction, fatigue[15], originating from his long hours of continuous duty, night[16] flying environment lack of proficiency and the unfamiliar airport environment were stressors for the Captain and contributed negatively to his Situational Awareness.

As a result of the above, the a/c energy was mismanaged, as a descent was performed with a rate of descent less than required to be at the altitudes authorized by the ATC. As verified in the approach procedure simulation, with a continuous descent from LARKI at a descent rate of 500 fpm and a ground speed of 130 kt, the a/c height in the simulation at 2.8 NM was 2770 ft. Based on this, it is estimated that from LARKI to 2.6 NM[17] from SAM VOR/DME, the a/c descent

[15] Taking into account the initial time of departure from LLHZ and the delays in departure from LLHZ and LLHA at 17:04:12 h, the time of a/c crash, the Captain had completed at least 07:34:12 h of continuous duty.

[16] According to par.1.18.4, from 16:53 h is considered night.

[17] Distance 15.4 NM, based on the published AIP approach procedure and estimated mean ground speed 130 kt.

continued continuously with an average descent rate of 530 fpm to 600 fpm and an average ground speed[18] of 130 kt, which is consistent with the estimated altitude of 2000 ft - 2500 ft by the ATC.

The a/c energy mismanagement, led to a high energy approach, where at 2.6 NM it had an estimated altitude higher than that authorized.

At 17:01:49 h, while the a/c was approaching the LGSM SAM VOR/DME in a night flight environment, the a/c was estimated[19] to be approximately 1.88 NM from the SAM VOR/DME, heading 358º and altitude 2116 ft (Anx. 5.3, Fig 3), while the Captain probably was using the autopilot in Navigation (NAV) Mode. The Altitude Hold (ALT HOLD) mode was disengaged as the latter is used to maintain the a/c altitude. The lights visible to the Captain, as verified by the approach procedure simulation, corresponded to the runways 09 and 27 end (red) lights and the control tower beacon green light.

The Captain in his report to ATC, did not mention that he had the runway in sight probably because, due to a/c position, the runway view angle[20] was higher than the cockpit 'cut-off ' angle. At the same time, it cannot be ruled out the possibility that the airport apron flood lights, because of their intensity, probably have covered part of the runway edge light (Anx. 5.10, Photos 12 and 13).

At 17:02:15 h, when the Captain reported being too high, the a/c was estimated to be 1.04 NM from the SAM VOR/DME and 1900 ft altitude (Anx. 5.3, Fig. 3). From the altitude-distance relationship between the a/c and the airport, it was not considered feasible the northwest direction descent, in the airport circle, in order to be on runway 09 final.

Considering that the cloud and visibility conditions (CAVOK) were above the minimum limits for VMC (Anx 5.12, Table 3), the Captain having the airport in sight, accepted ATC's proposal to fly in the airport circle in order to loose altitude. The altitude lose should not be greater than MDA, until Captain has in view the flight environment[21].

Based on the course and average rate of descent, it is estimated that the a/c overflown the SAM VOR/DME at an altitude of 1630 ft. The Captain executed a right turn following an estimated

[18] As derived from the total distance of 15.4 NM, based on the approach procedure and the time at LARKI and at 2.6 NM from SAM VOR/DME.

[19] Based on the estimation of mean altitude of 2300 ft at 2.6 NM and mean rate of descent 558 fpm.

[20] At an altitude of 2116 ft and distance 2.03 NM from the runway 09/27 edge, the view angle was 9.6º.

[21] The runway environment includes features such as the runway threshold or approach lighting aids or other markings identifiable with the runway. (ICAO Doc 8168 Section 5, Chapter 6).

course[22] as depicted in Anx. 5.3, Fig. 3 and Fig. 4, while the a/c right turn was consistent with a bank angle of 36°, a value that is within the bank angle range according to a/c "Normal Category" certification.

During the a/c flight of over the airport, based on the report to ATC, the Captain had visual contact with the runway and turned right on a southeasterly heading. During the straight and level flight of the a/c over the sea (Anx 5.4, Photos 5 and 6), the runway was out of the Captain's visual field, as he had it behind and to his right and made a right turn to perform a visual airport circle flight.

As determined by examination of the video footage and depicted in Anx. 5.4, Photo 7, the a/c roll during the right turn increased to an angle approaching 90°. The a/c attitude is consistent with the ATC interview, who indicated that he saw a steady red light (left-hand navigation light), which should not have been visible to the ATC if the a/c attitude was not unusual. Also, the a/c high bank angle resulted in lift reduction which led in the a/c pitch down, as observed in Anx. 5.4, Photo 8.

From the macroscopic examination of the fractures in the right-hand position rudder pedals and the deformation of the brake linkages in the same position, the deformation of the flaps lever, the cabin air and cabin heating levers and the forensic examination, it is concluded that the Captain occupied the cockpit right-hand position probably to have airport better view when performing the right-hand turns during the approach phase.

As shown in Photos[23] 12 and 13 of Anx. 5.10, the apron lights illumination was intense and at the a/c altitude when flying over the sea, possibly some of the runway edge lights were overlapped by the apron flood lights. Also, during the right turn, the a/c descending right wing hidden part of the Captain's Visual field, despite the fact that he occupied the right cockpit position.

The above factors made it difficult to locate the runway and as a result, while the a/c was in a right turn over the sea, the Captain fixated with runway detection, overlooking the a/c control of the flight. At the same time, due to the high roll right turn over the sea in a night environment, the Captain lost the visual reference points of the surrounding area, which contributed to his spatial disorientation[24].

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[22] The estimated course derived from the available video footage and information gathered from conducted interviews.

[23] The captured photos depict the runway edge lights in high intensity. On the contrary the runway edge lights were in medium intensity when the accident happened.

[24] Spatial Disorientation: is defined as the inability of a pilot to correctly interpret aircraft attitude, altitude or airspeed in relation to the Earth or other points of reference.

The above contributed to the Captain's loss of Situational Awareness, which resulted in Captain's failure to the in time bank angle control and correction of the a/c when turning. This led the a/c at bank angle probably greater than 90°, which was also augmented by the a/c overbanking tendency and led it to loss of control in flight.

From Photos 12 and 13 of Anx. 5.10, it can be observed that the illumination of the coastal lighted road was not visible along its entire length, which reduces the likelihood that the pilot perceived the visible lighted coastal road as the airport runway.

From the available wreckage macroscopic examination, it was determined that the Captain, prior to the a/c crash into the sea, attempted to correct the right bank of the a/c by placing the yoke in left roll position, Photo 3. Due to the a/c unusual attitude and the low altitude, the Captain's corrective action was not sufficient to restore the a/c from the unusual attitude and prevent it from crashing the sea.

Due to the failure of a/c finding and recovering, it was not feasible to examine it and its engine. A macroscopic examination of the available wreckage indicated that the deformations combined with the injuries of the two persons were consistent with the a/c a high kinetic energy crash, which is consistent with the operation of the engine, as shown by the interviews conducted.

The engine operation precludes the possibility of the a/c fuel starvation. From the available transcripts, no technical malfunction was reported by the Captain and the examination of the available wreckage in conjunction with the interview data and examination of the video footage shows no evidence of a technical malfunction.

From the available data, the a/c hours flown, after the 200 h last inspection and up to 2021-07-30 did not exceed the required hours for the next scheduled inspection of 50 h.

Based on the macroscopic examination, following the layout reconstruction of the two controls yokes, and of the cabin seats, it is established that the caused deformations are consistent with the a/c attitude during crash.

2.3 Aircraft Captain

2.3.1 Captain's Proficiency

From the data review in par. 1.5.2, it is established that the time period[25] between the accident flight and the last night environment flight of 0.9 h, together with the corresponding total flight

[25] 6 months and 4 days for night flight.

hours after this rating certification, are factors that did not assure the necessary flight proficiency for night environment visual flight, as required by the LGSM instrument approach procedure.

In addition to the above, from the information of par. 1.5.2, the time period[26] between the Captain's last Instrument flight and the date of the accident, provided that no intermediate flights with instructor presented had taken place, are factors which may not have contributed to the Captain's proficiency.

It is considered that if during the above periods, the Captain had flown in respective conditions with an instructor present, especially in a night environment, then the level of the pilot's proficiency would have been maintained.

2.3.2 Captain's Assessment

From the Instrument rating forms review, that were used for pilot assessment, it was found that a test form which was not valid, as it had been replaced by a later one, was used when the pilot was assessed satisfactory. In addition to the differences between the two forms as referred to in par. 1.5.3, during the first unsatisfactory assessment the Captain was not assessed in all form items, which is contrary to the practical assessment procedure for aeroplanes and helicopters.

The policy followed by the CAA of Israel regarding the non-disclosure of the assessment results to the next assessor was probably aimed at avoiding his bias. However, it probably deprives the next assessor of information about the competence of the person assessed and especially about the tasks that he had failed.

As a result, during reassessment, the failure tasks of are not emphasized and may be characterized as not applicable. The accident flight Captain on his satisfactory instrument rating assessment, had fields on the examination form marked as not applicable, whereas on the two previous assessments the same fields had not been or had unsatisfactory been assessed.

Among these was the *"STAR's"* field where the pilot was not assessed because the field was marked as not applicable, as it was considered that his successful assessment of the *"SID"* field was sufficient, despite the fact that it was contrary to the prescribed procedures. It should be noted that the successful execution of the STAR and SID procedures are dependent on the a/c energy management by the Captain and have a direct influence on the energy status of the a/c during its arrival and departure and the subsequent continuation of the flight.

[26] 2 months and 24 days for instrument flight.

3 Conclusions

3.1 Findings

3.1.1 Captain

- He had his certificates and ratings current, except for his Night CVFR rating which had expired as of 2021-05-30.
- He was satisfactory assessed in Instrument flight having assessment tasks marked as not applicable, whereas in the two previous unsatisfactory assessments the respective tasks had not been assessed or had been assessed unsatisfactorily.
- The Instrument flight assessment form used in its second and third (successful) assessment was not valid as it had been replaced by a later one.
- He did not have the required Proficiency to fly in a night environment.
- The two occupants of the a/c had injuries consistent with the a/c attitude and severity of the crash.

3.1.2 Aircraft Flight

- The a/c departed with 01:43 h delay to LGSM Airport.
- Although the Captain denied departing at 13:20 h due to the expected night arrival at LGRP, it could not be substantiated the reason for not canceling his departure from LLHA at 12:43 h, even though he would arrive at the LGSM at night.
- After LARKI point, there was no a/c track radar recording and it cannot be substantiated whether the a/c descent was performed in accordance with AIP described procedure.
- The ATC repeatedly described the approach procedure to the Captain.
- The Captain was requesting re-confirmation of part of ATC's instructions and re-approval of the approach clearance as a result of the distraction due to the increased workload.
- During the a/c approach, there were factors that adversely affected the Captain's Situational Awareness.
- During the approach there was failure in a/c energy management, resulting the a/c being in short distance to the LGSM at high altitude.
- The Captain, at 2.6 NM from the SAM VOR/DME, did not discern the airport runway.
- The Captain, at the suggestion of ATC, accepted to fly in the airport circle in order to loose altitude.

- The illumination of the airport apron area was bright and at the altitude at which the a/c was flying over the sea, probably part of the runway edge lights was overpowered by the apron lights.
- During the right turn over the sea, the a/c descending right wing covered part of the Captain's visual field.
- The illumination of the coastal lighted road was not visible along its entire length, which reduces the possibility that the Captain perceived the visible coastal road lights as the airport runway.
- When the a/c was in a right turn, the captain fixated with the runway detection while he lost visual reference points of the surrounding area, fact that contributed to his Spatial Disorientation.
- Failure of the in-time a/c bank angle check and correction while in turn, resulted in Loss of Control in Flight.
- At the time of the a/c crash, the captain had completed at least 07:34:12 h of continuous duty.

3.1.3 Aircraft

- The a/c certificates were valid.
- Based on the available records, the a/c did not have Insurance Contract.
- The oil leakage that occurred at LLHZ airport did not contribute to the accident.
- Based on available information, there was no pending a/c maintenance.
- There were no indications of a/c technical problem prior to its crash.
- At the time of impact, the two yokes were in the left roll position.
- The search operation to locate and recover the a/c did not reveal the a/c or any part of it.
- From the recovered wreckage, it was determined that the a/c was completely destroyed by the crash and its deformations are consistent with the a/c position during the crash.

3.2 Probable Causes

From the accident Investigation, it was determined that the probable cause of the accident was the absence of timely control and correction of the a/c bank angle, during the airport circling right turn, which led to Loss of Control Flight.

3.3 Contributing Factors

- The pilot's Spatial Disorientation during the downwind entry right turn, with high bank angle over the sea in a night environment.
- The Captain's fixation with runway detection.
- The pilot's lack of proficiency in night flight environment combined with the aerodrome unknown night environment and the pilot's fatigue.
- The failure of the a/c energy management during the approach.

4 Safety Recommendations

4.1 To the Civil Aviation Authority of Israel.

- From the Captain's records review, it was found that in his Instrument rating assessment a form, which was not valid, was used in two out of three assessments, in the first assessment he was not assessed in all form items, while in the "STAR's" item the Captain was not assessed as it was considered that his successful assessment in the item "SID" was sufficient.

  The above actions were not consistent with the existing Civil Aviation Authority (CAA) of Israel procedures, regarding the practical assessment of aeroplanes and helicopters, which stipulates that all items and flight exercises should be assessed.

  At the same time, the current CAA of Israel policy of not disclosing the results of previous assessments to the next assessor, probably deprives important information about the competence of the pilot assessed and especially in the areas that had failed, resulting some items might be considered not applicable during the re-assessment.

  The combination of the above results in the successful assessment of specific rating, but without actually, all the tasks of the assessment form being assessed successfully.

2025-01AV: It is recommended that the CAA of Israel take appropriate corrective actions to enhance standardization in the implementation of existing assessment procedures by each examiner concerned.

2025-02AV: It is recommended that the CAA of Israel review the existing pilot's re-assessment policy, in terms of the non-disclosure of assessment remarks to the next assessor, in order to comply with international practice.

- Examination of the a/c records revealed that the a/c had no insurance contract, due to its non-requirement for private a/c's, in the state of registry.

  This made the flight to the LGSM unfeasible, as it was contrary to the European Regulation (EU) 785/2004 requirements, which governs the insurance of a/c's flying into or over the territory of a Member State or to / from a Member State.

2025-03AV: It is recommended the CAA of Israel to promote the awareness for insurance requirement of the general aviation flights to European Union countries, in accordance with current European legislation.

4.2 To the Hellenic Civil Aviation Authority

- In the AIP-published VOR/DME Instrument approach, is predicted flight to SAM VOR/DME and then a Circling south of the runway should be performed. The review of the above approach procedure in the LGSM and the corresponding NDB procedure did not reveal the existence of any visual prescribed track.

  In ICAO Doc 8168, Section 5, Chapter 6, is stated:

  "In those locations where clearly defined visual features permit (and if it is operationally desirable), a State may prescribe a specific track for visual maneuvering in addition to the circling area."

  Provided the airport geographical specificities and its operation at night, the execution of a visually non prescribed track, is of significant high risk. For this reason and in the context of circling approach risk mitigation, it is considered that the publishing of a visual prescribed track in the AIP would standardize the approach, helping crew's workload reduction, especially in single-crew a/c's, thus improving their Situational Awareness.

2025-04AV: It is recommended that the Hellenic Civil Aviation Authority proceed with the study and publication in the AIP of a Prescribed Track for the visual section of the landing approach on runway 09 of the LGSM, for general aviation aircrafts.

New Philadelphia, 12/6/2025

HARSIA CHAIRMAN

Georgios Dritsakos

THE MEMBERS

C. Valaris

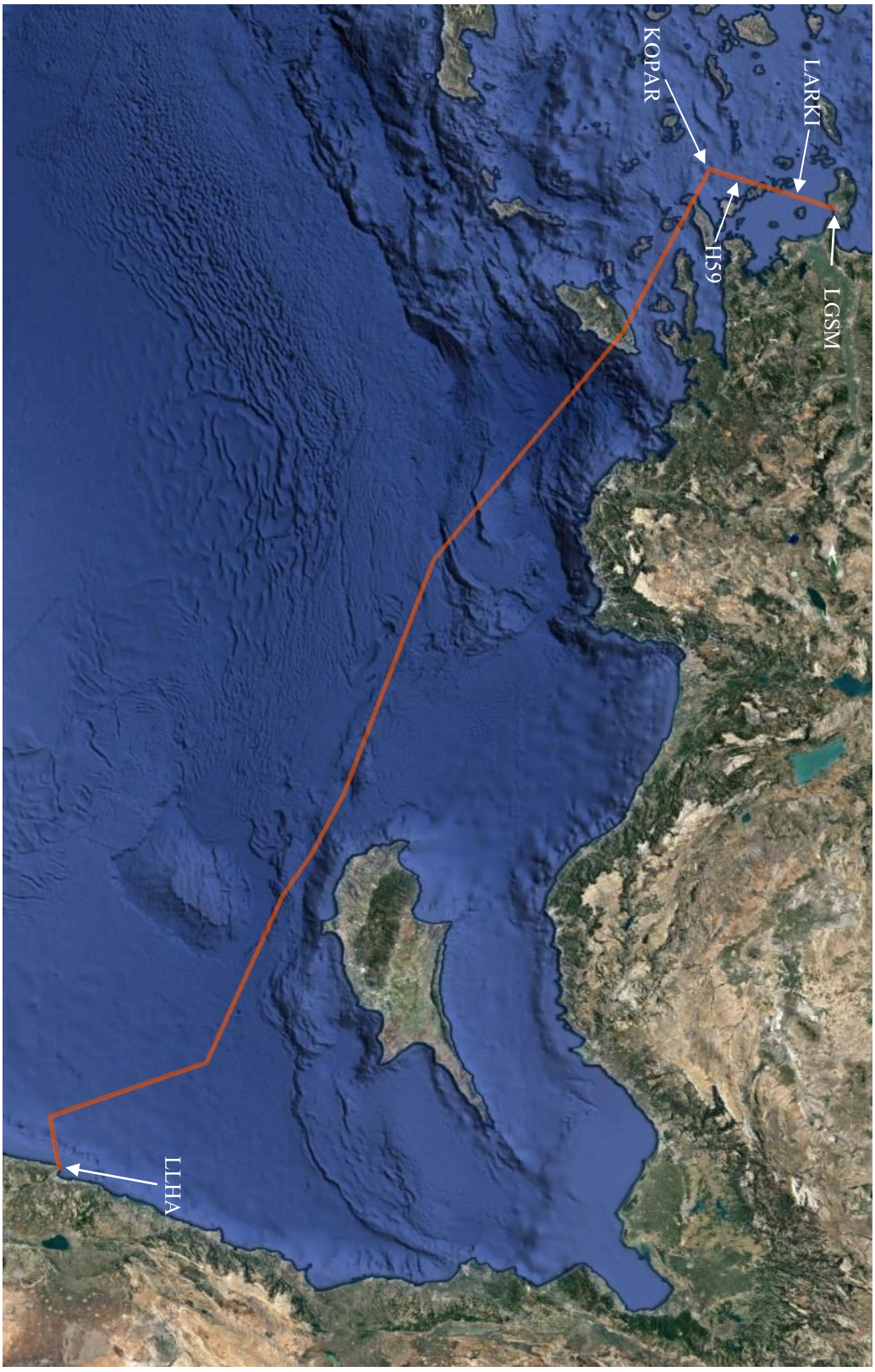
G. Flessas

THE SECRETARY

V. Fouseki

5 Annexes

5.1 A/C flight track according to Flight Plan.



Picture 2: A/C flight track according to flight plan and the airports of departure and arrival.

5.2 A/C track transcript

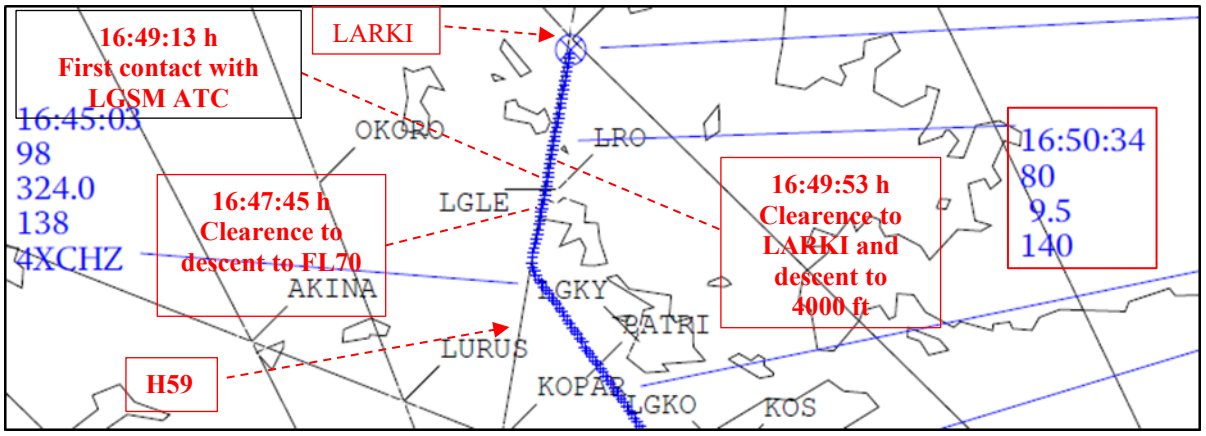


Fig.: 1: 4X-CHZ a/c track on airway H59 heading to LARKI point.

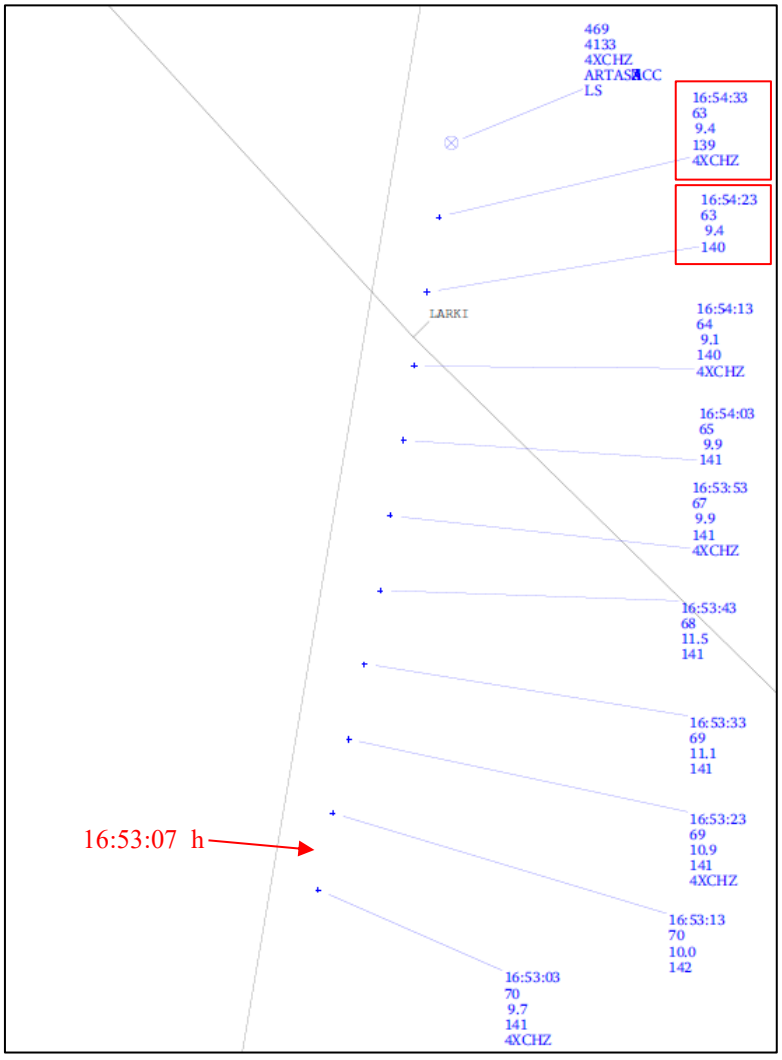


Fig.: 2: 4X-CHZ a/c track over LARKI point and its last Radar capture point.

5.3 A/C estimated track from Final Approach Fix to point of crash

Fig.: 3: A/C estimated track after FAF (Final Approach Fix).

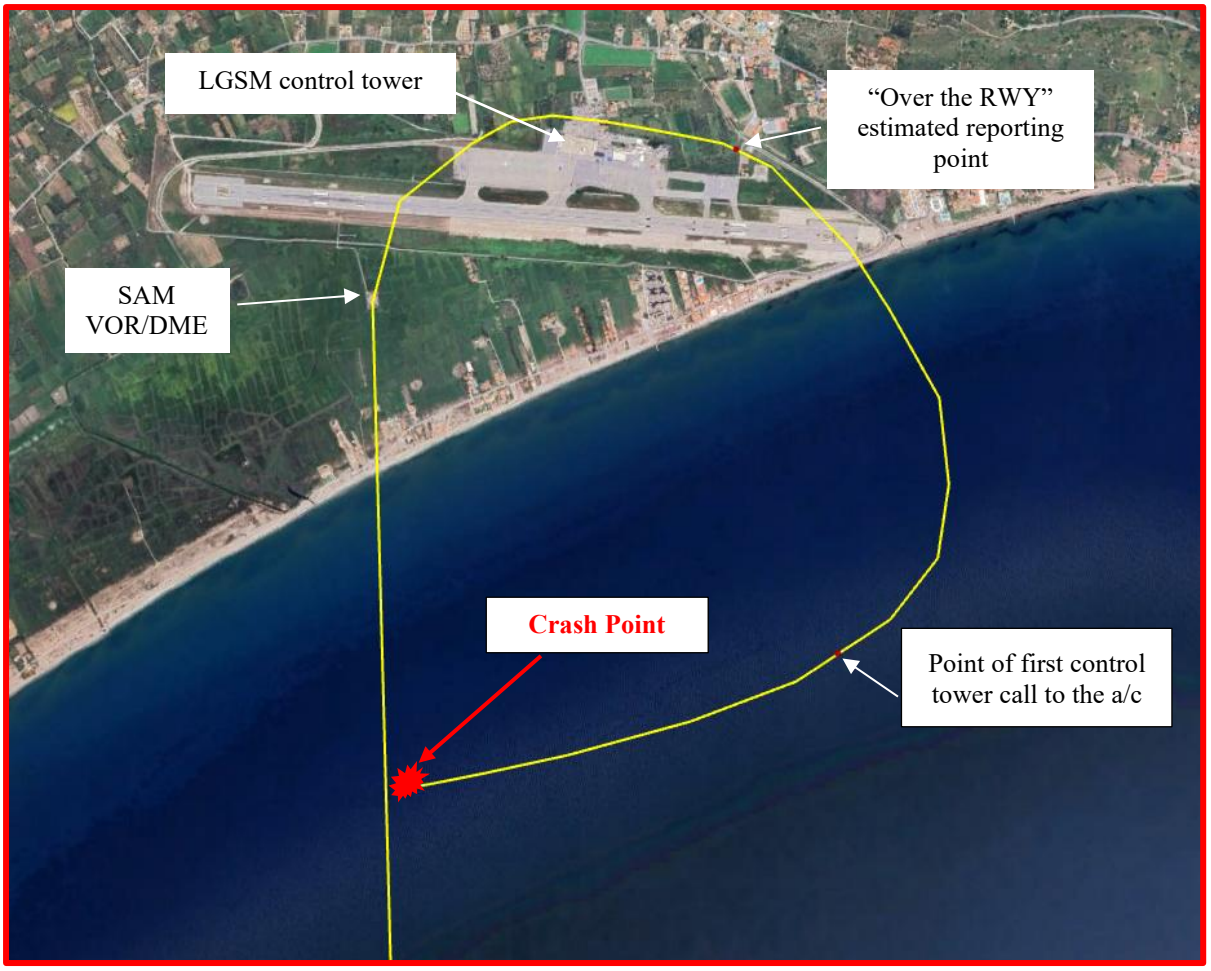


Fig.: 4: Detail A, estimated a/c track based on video footage, after SAM VOR/DME until its crash.

5.4 Aircraft video footage screenshots.

Photo 5: The a/c as captured on the 29th s of video footage, before turning right to enter the south downwind leg.

Photo 6: Detail A, The a/c on the 29th s of video footage, before turning right to enter the south downwind leg.

Photo 7: The a/c on the 31st s of video footage during its approximately 90o bank angle right turn.

Photo 8: The a/c on the 31st s of video footage during its approximately 90o bank angle right turn and its negative pitch angle.

Photo 9: A/C screenshot during the 33rd s of video footage, 1 s prior to its crash.

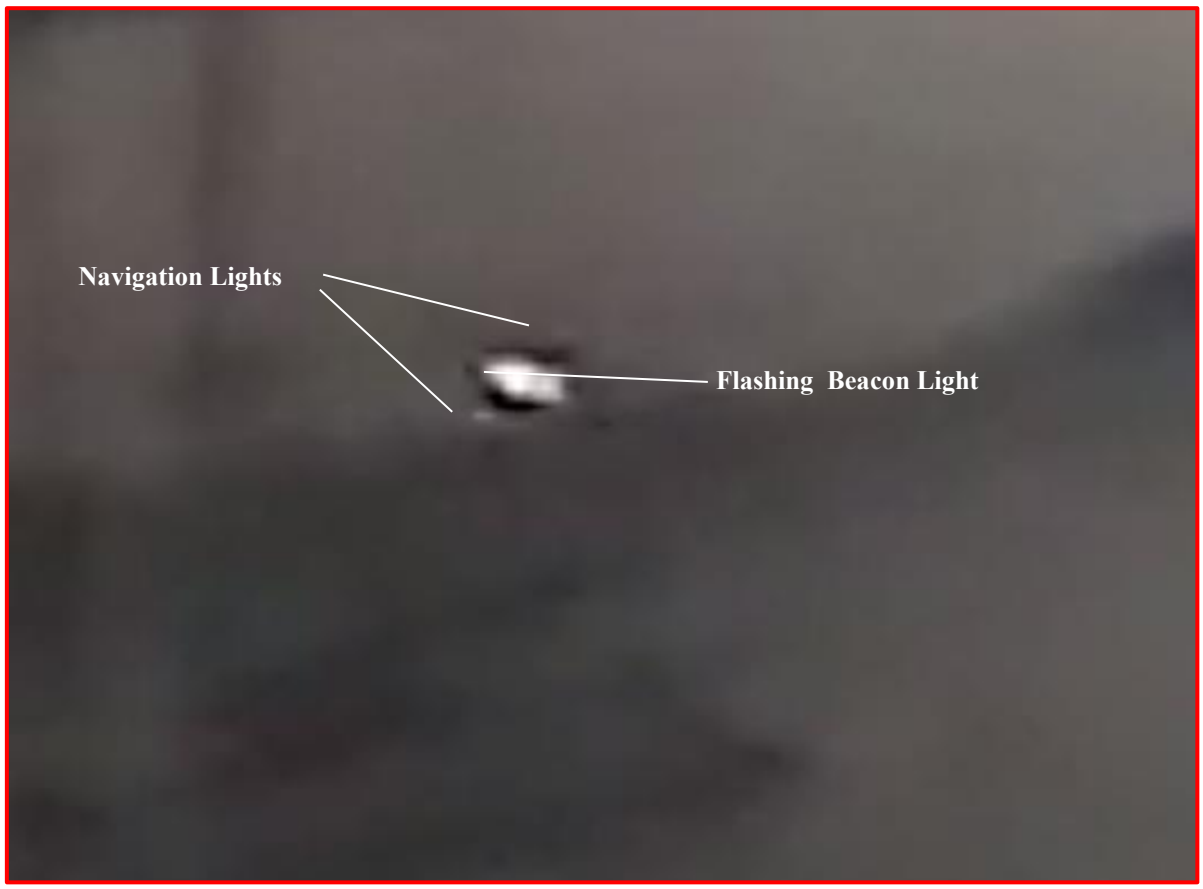
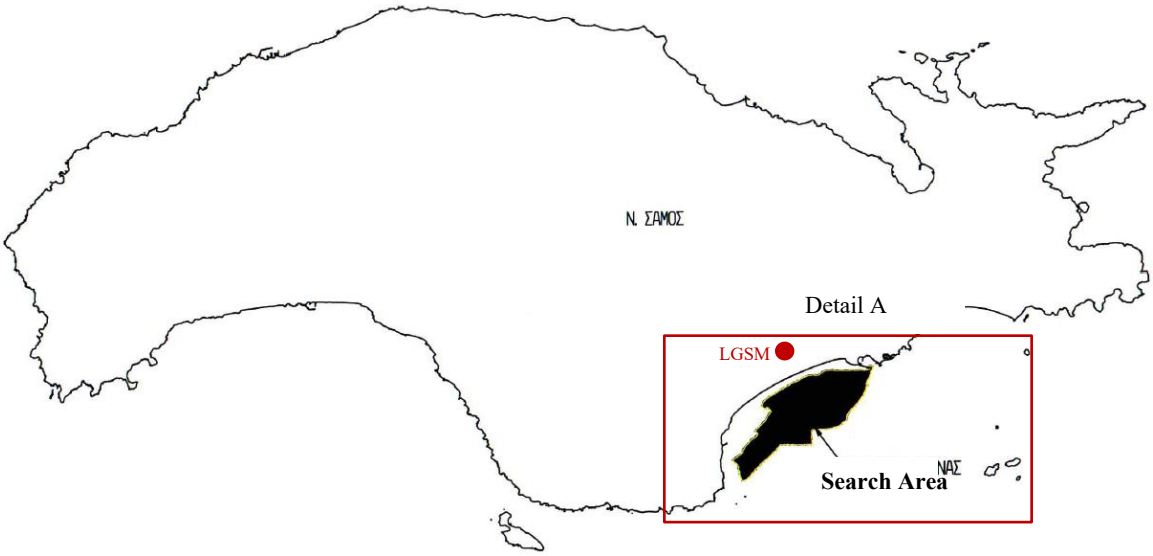
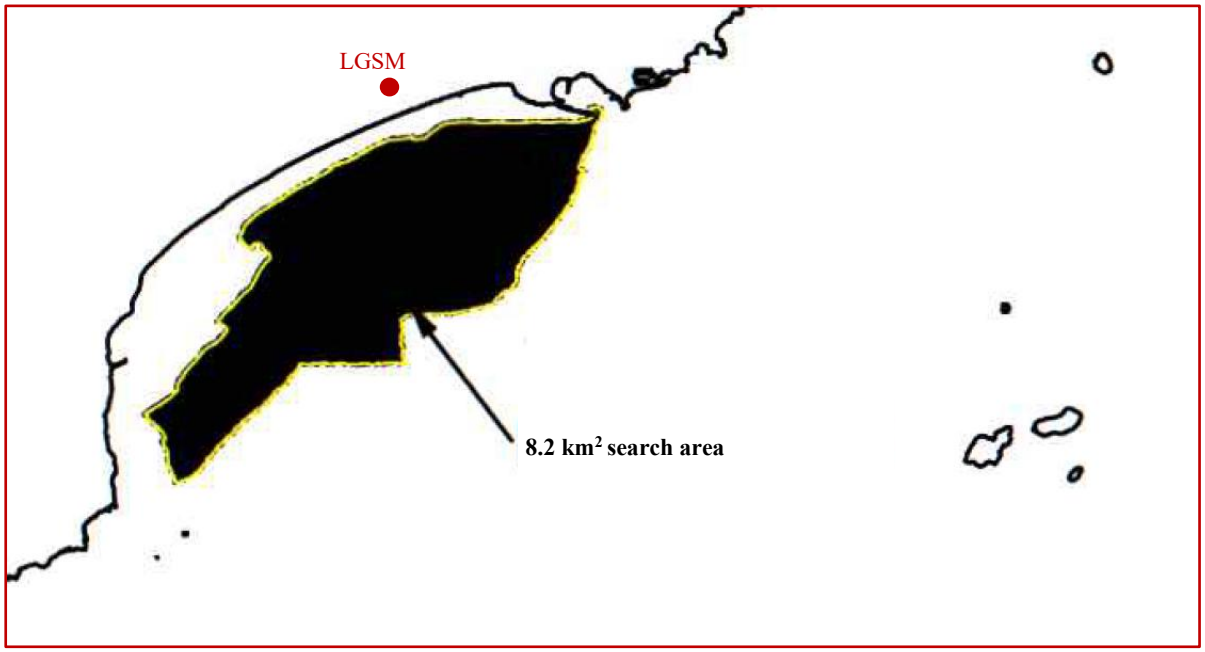


Photo 10: Detail A, the a/c 1s before its crash, where its right roll is distinguished.

5.5 A/C discovery search area

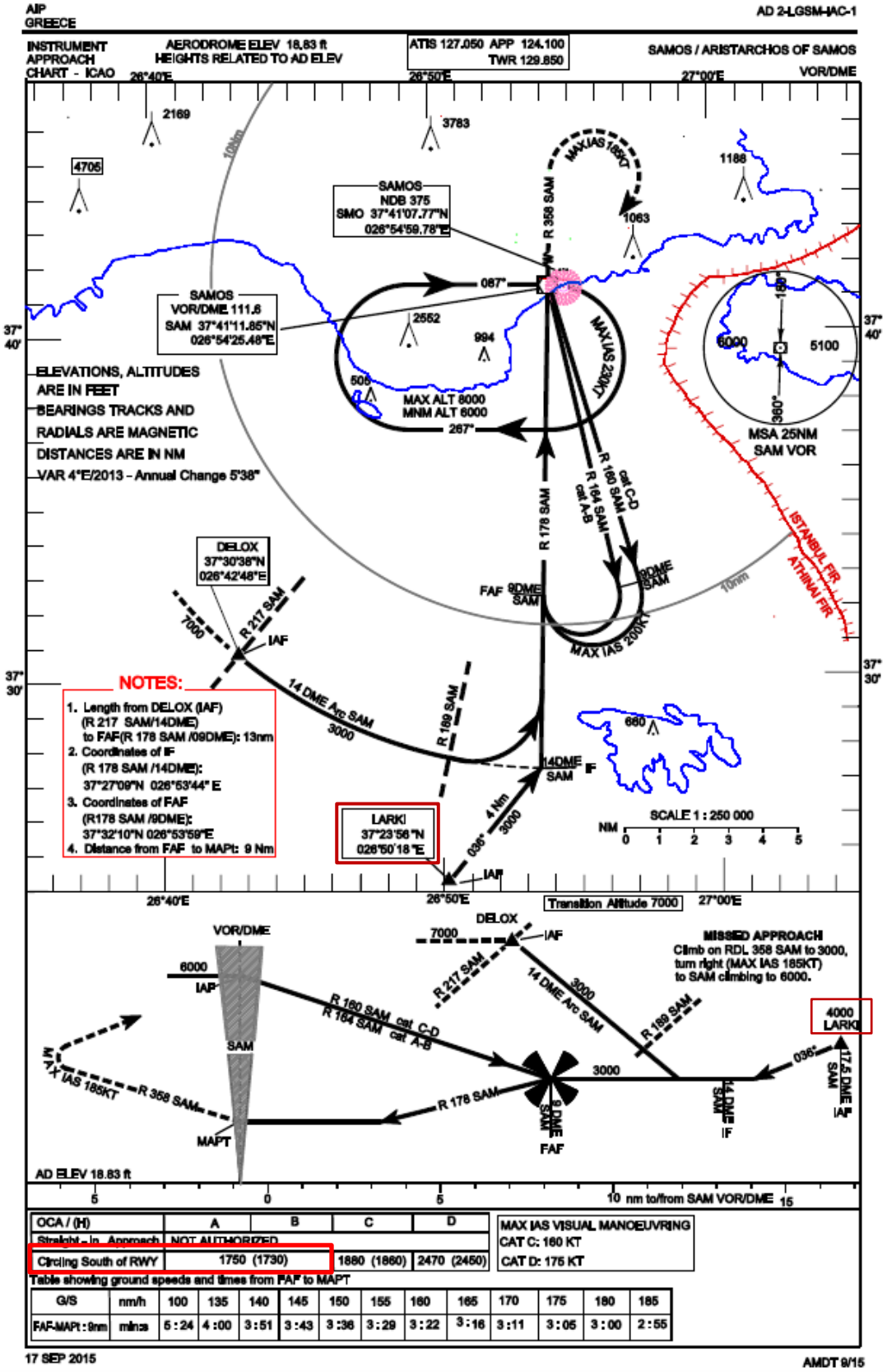


Picture 3: A/C discovery search area.



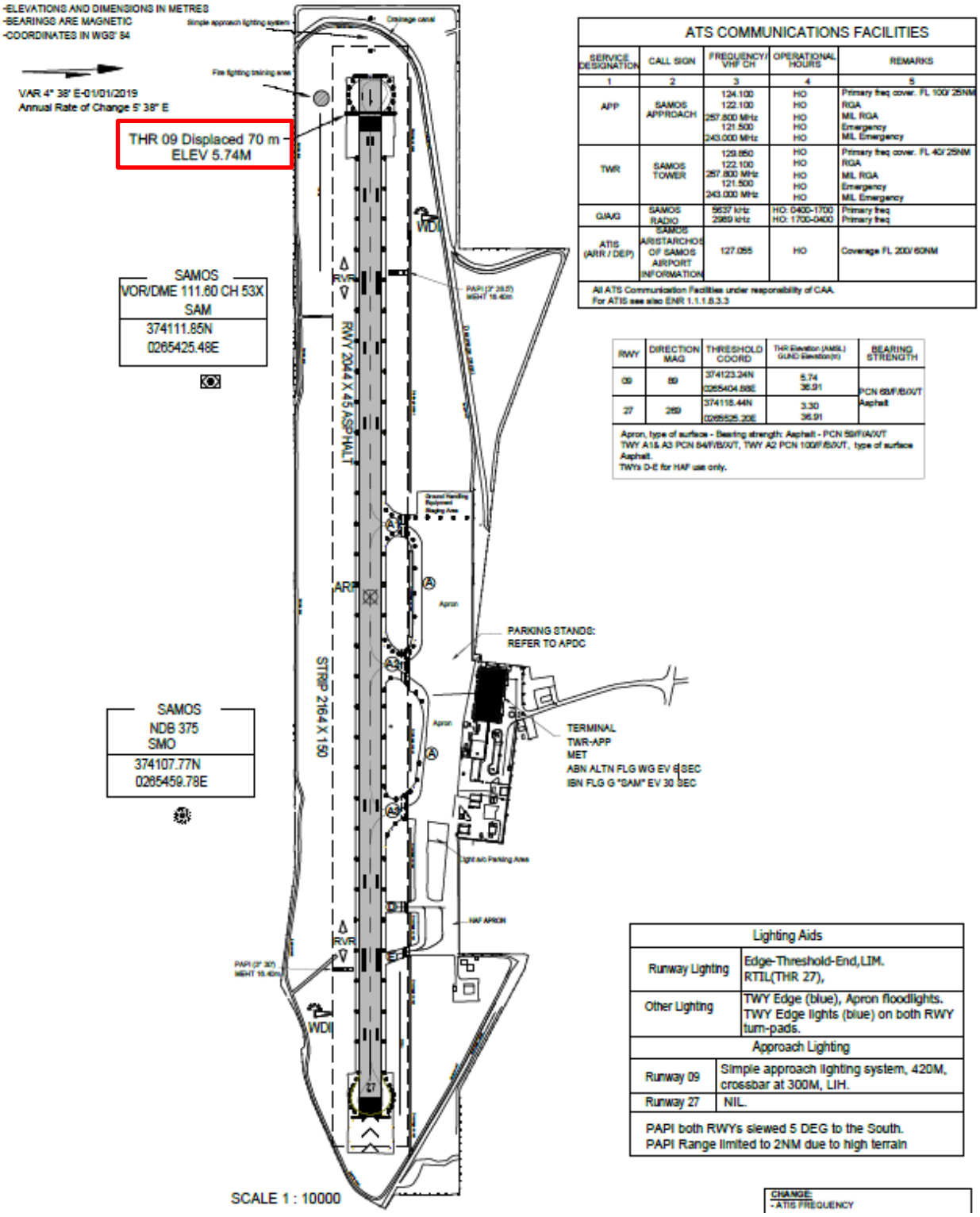
Picture 4: Detail A of search area.

5.6 Samos Airport Instrument Approach Procedure



Picture 5: LGSM published VOR/DME approach procedure.

5.7 LGSM View



ATS COMMUNICATIONS FACILITIES				
SERVICE DESIGNATION	CALL SIGN	FREQUENCY/ VHF CH	OPERATIONAL HOURS	REMARKS
1	2	3	4	5
APP	SAMOS APPROACH	124.100 122.100 257.800 MHz 121.500 243.000 MHz	HO HO HO HO HO	Primary freq cover. FL 100/ 25NM RGA MIL RGA Emergency MIL Emergency
TWR	SAMOS TOWER	129.850 122.100 257.800 MHz 121.500 243.000 MHz	HO HO HO HO HO	Primary freq cover. FL 40/ 25NM RGA MIL RGA Emergency MIL Emergency
GIA/G	SAMOS RADIO	5637 kHz 2989 kHz	HO: 0400-1700 HO: 1700-0400	Primary freq Primary freq
ATIS (ARR / DEP)	SAMOS ARISTARCHOS OF SAMOS AIRPORT INFORMATION	127.055	HO	Coverage FL 200/ 60NM
All ATS Communication Facilities under responsibility of CAA. For ATIS see also ENR 1.1.1.8.3.3				

RWY	DIRECTION MAG	THRESHOLD COORD	THR Elevation (AMSL) GUND Elevation(m)	BEARING STRENGTH
09	89	374123.34N 0265404.88E	5.74 36.91	PCN 68/F/B/X/T Asphalt
27	269	374118.44N 0265525.20E	3.30 36.91	
Apron, type of surface - Bearing strength: Asphalt - PCN 58/F/A/X/T TWY A1& A3 PCN 84/F/B/X/T, TWY A2 PCN 100/F/B/X/T, type of surface Asphalt. TWYs D-E for HAF use only.				

Lighting Aids	
Runway Lighting	Edge-Threshold-End,LIM. RTIL(THR 27),
Other Lighting	TWY Edge (blue), Apron floodlights. TWY Edge lights (blue) on both RWY turn-pads.
Approach Lighting	
Runway 09	Simple approach lighting system, 420M, crossbar at 300M, LIH.
Runway 27	NIL.
PAPI both RWYs slewed 5 DEG to the South. PAPI Range limited to 2NM due to high terrain	

CHANGE:
- ATIS FREQUENCY

5.8 LGSM Lights

RWY Designator	APCH LGT Type Length Intensity	THR LGT Colour Wingbars	PAPI VASIS Angle Distance from THR (MEHT)	TDZ, LGT Length	RWY Centre-line LGT Length Spacing, Colour Intensity	RWY edge LGT Length Spacing Colour Intensity	RWY End LGT Colour Wingbars	SWY LGT Length Colour	Remarks
1	2	3	4	5	6	7	8	9	10
09	Simple approach lighting system. 420M with a crossbar at 300M LIH	Green	PAPI / Left 3° 28.5' 312M (16.40M)	NIL	NIL	White LIH	Red	NIL	Blue turning circle lights on both runways. PAPI both RWYs slewed 5 DEG to the South. PAPI Range limited to 2 NM due to high terrain
27	NIL	Green RTIL	PAPI / Left 3° 30' 284M (16.40M)	NIL	NIL	White LIH	Red	NIL	

1	ABN/IBN location, characteristics and operational hours	ABN: At the Tower building, ALTN FLG green and white, every 6 SEC, HO: HN and IMC. IBN: At the Tower building, FLG green, coding "SAM", every 30 SEC, HO: HN and IMC.
2	LDI location and LGT Anemometer location and LGT	LDI: NIL WDI: 2 WDI lighted Anemometer: 2 lighted.
3	TWY edge and centre line lighting	Edge: All TWY
4	Secondary power supply/switch-over time	Available.
5	Remarks	Apron: Flood lights. Flares in extraordinary cases.

Table. 2: Runway 09 and airport lights

5.9 Lighting conditions at the time of accident

Photo 11: The ambient lighting conditions at the time of the accident.
The photo was captured on 2021-09-16, 20:05 h local, in a West-southwest direction.
Sunset: 19:19 h LT.

5.10 Samos airport night environment photos

Photo 12

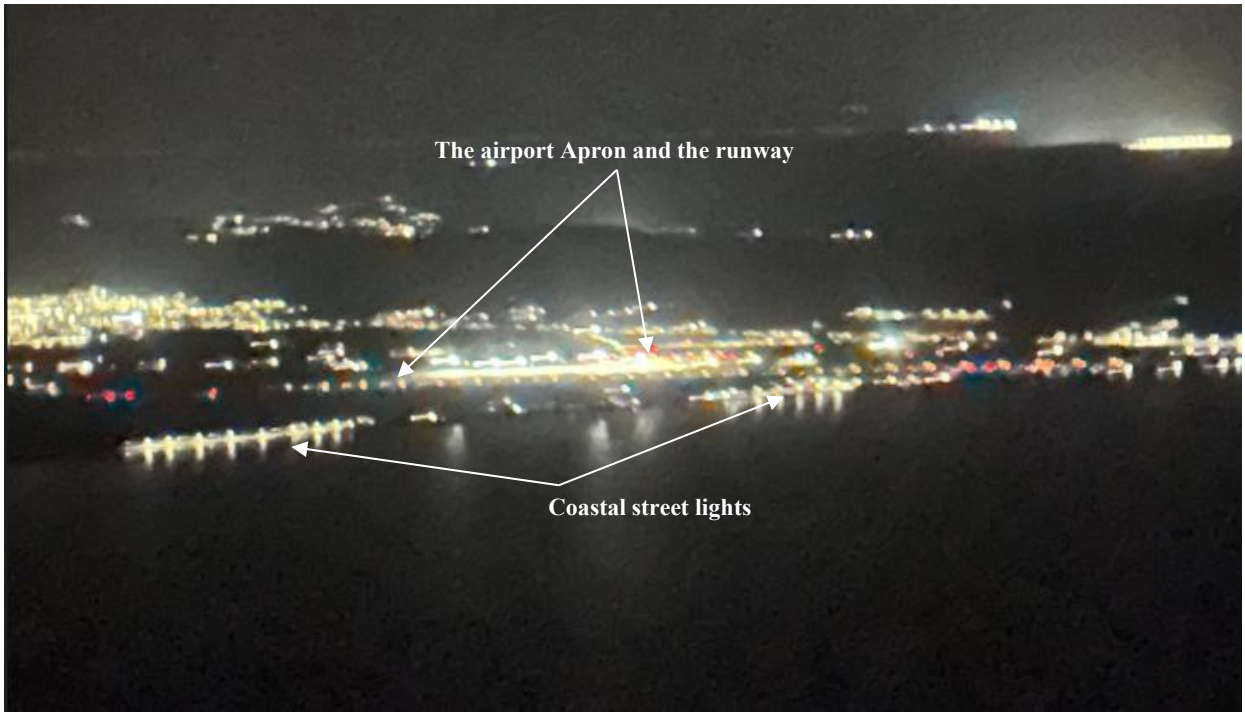
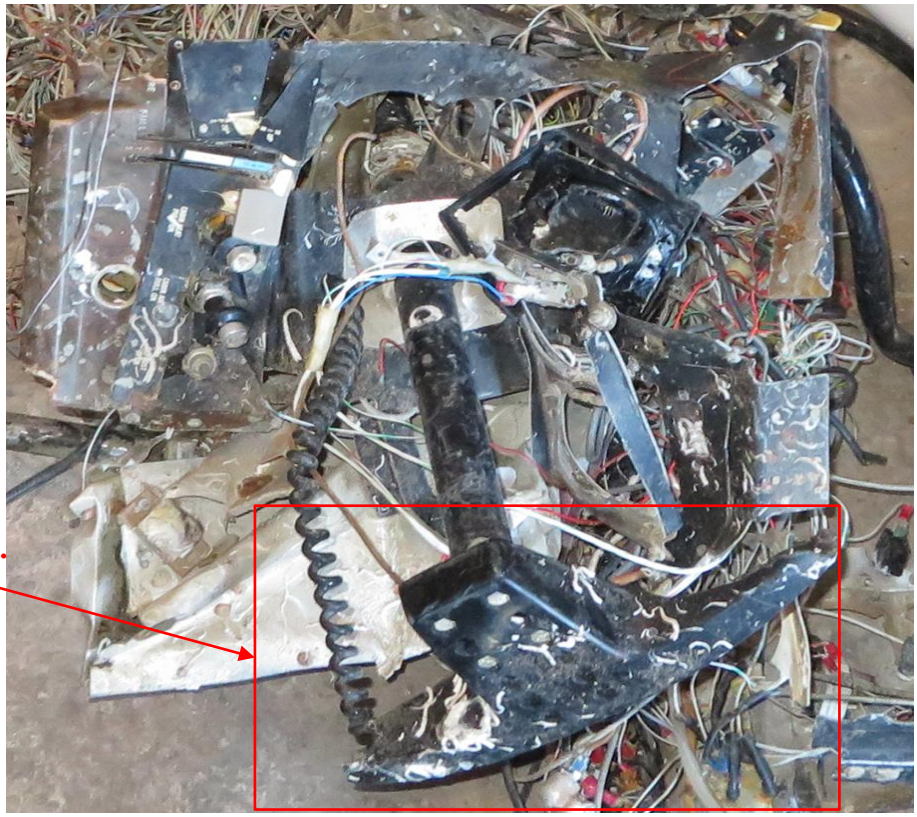


Photo 13

5.11 Wreckage examination

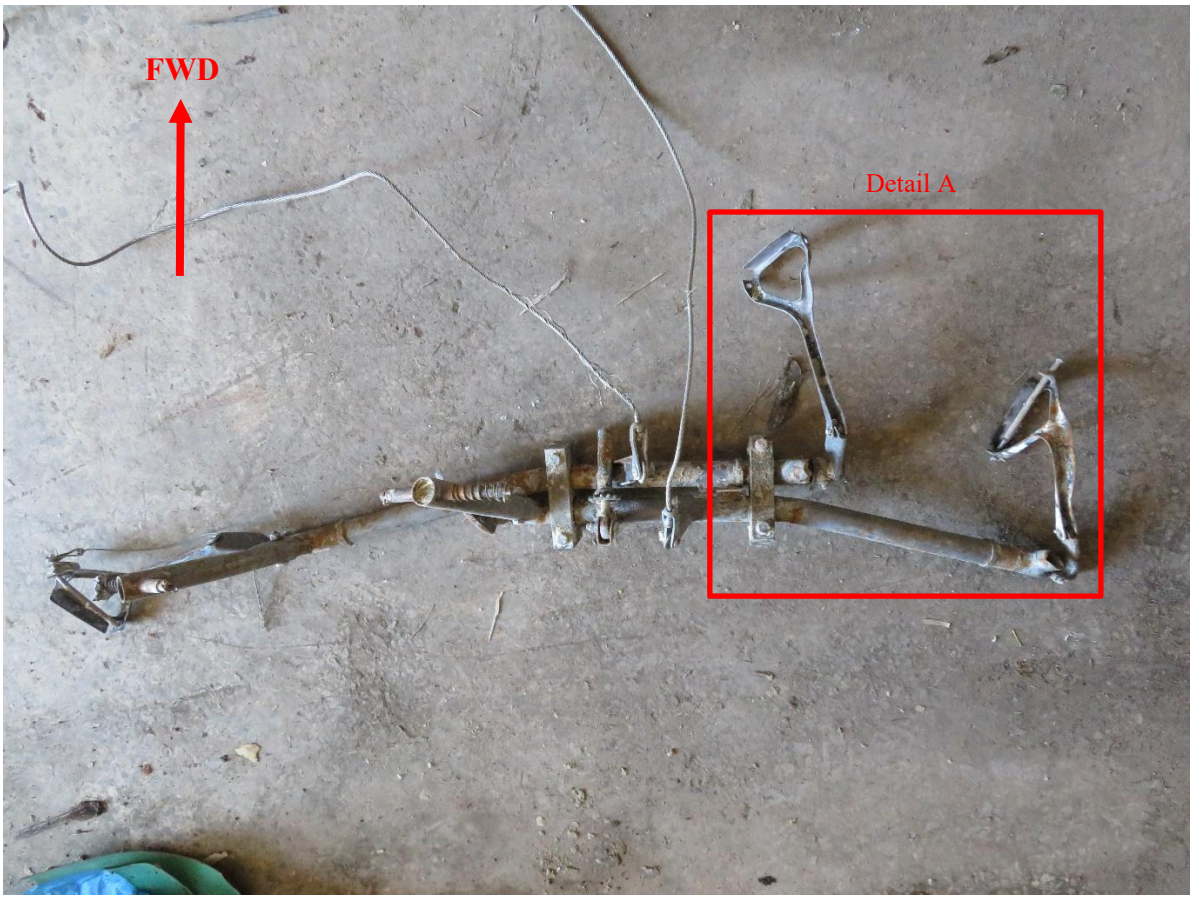
Photo 14: Part of recovered left Instrument panel.



Right Yoke.

Photo 15: Part of recovered right Instrument panel.

Photo 16:Right Instrument panel, the three switches right bending.



Φωτ. 17: Left and Right Pedal Bars and Brake Links.

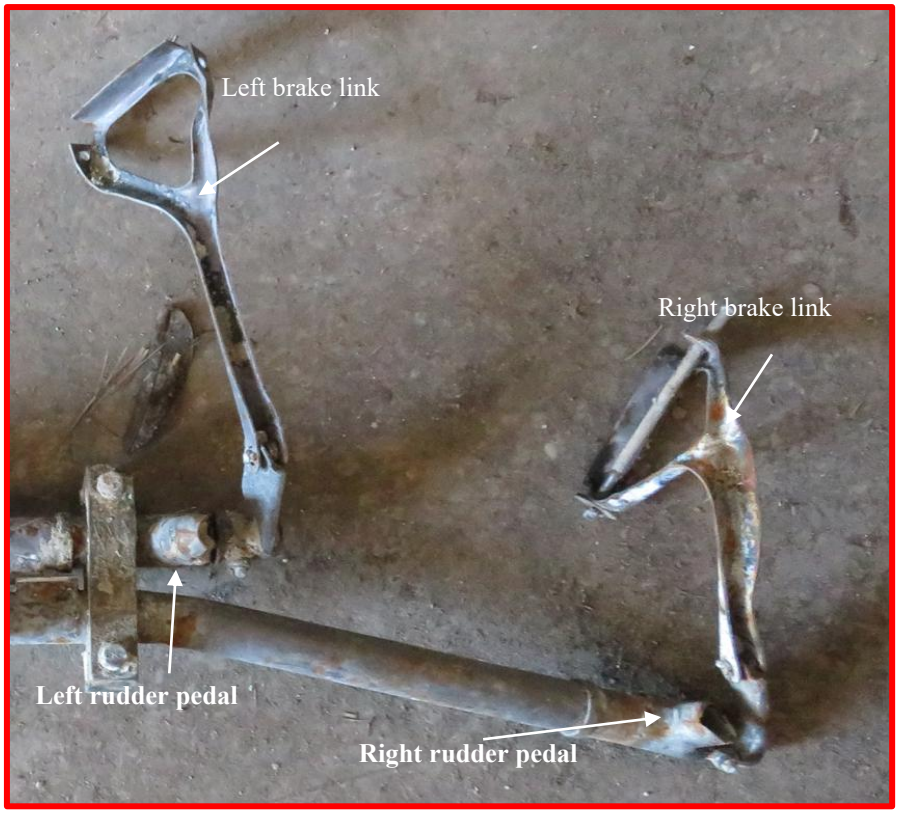


Photo 18: Detail A, right seat rudder pedal fractures.

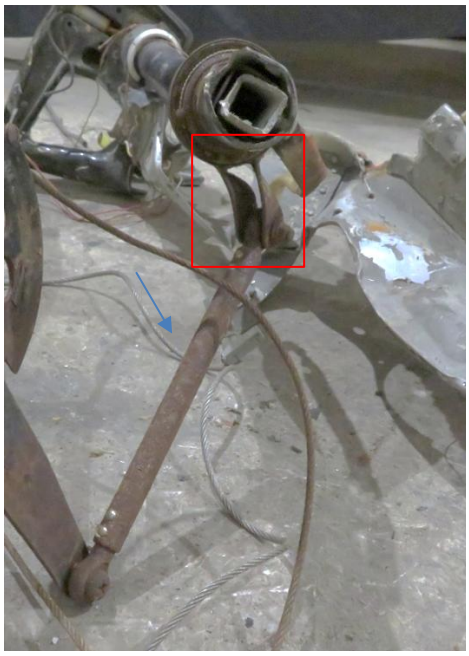


Photo 19: Left control column linkage

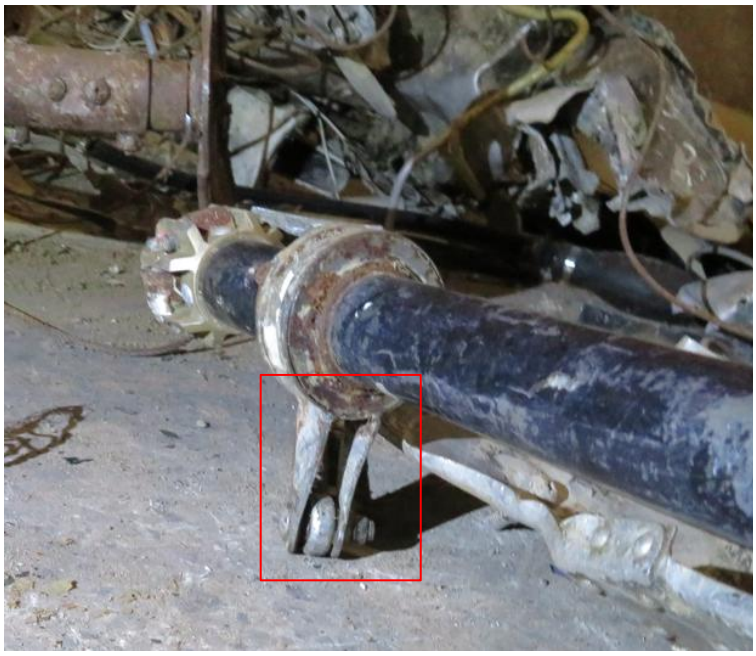


Photo 20: Right control column linkage

Photo 21: Rear seat frame showing the missing part of the right seat frame (white arrow).

Photo 22: The frame of the rear seat back, where fracture and deformation of the right back frame the left can be seen.

5.12 VMC Minima

TABLE OF VMC MINIMA			
Altitude band	**Airspace class**	**Flight visibility**	**Distance from cloud**
At and above 3 050 m (10 000 ft) AMSL	A (**) B C D E F G	8 km	1 500 m horizontally 300 m (1 000 ft) vertically
Below 3 050 m (10 000 ft) AMSL and above 900 m (3 000 ft) AMSL, or above 300 m (1 000 ft) above terrain, whichever is the higher	A (**) B C D E F G	5 km	1 500 m horizontally 300 m (1 000 ft) vertically
At and below 900 m (3 000 ft) AMSL, or 300 m (1 000 ft) above terrain, whichever is the higher	A (**) B C D E	5 km	1 500 m horizontally 300 m (1 000 ft) vertically
	F G	5 km (***)	Clear of cloud and with the surface in sight.

(*) When the height of the transition altitude is lower than 3 050 m (10 000 ft) AMSL, FL 100 shall be used in lieu of 10 000 ft.

(**) The VMC minima in Class A airspace are included for guidance to pilots and do not imply acceptance of VFR flights in Class A Airspace.

(***) During day:
a) flight visibilities reduced to not less than 1500m are permitted for flights operating:
i) at speeds of 140 kts IAS or less to give adequate opportunity to observe other traffic or any obstacles in time to avoid collision; or
ii) in circumstances in which the probability of encounters with other traffic would normally be low, e.g. in areas of low volume traffic and for aerial work at low levels;
b) helicopters are permitted to operate in less than 1 500 m but not less than 800 m flight visibility, if manoeuvred at a speed that will give adequate opportunity to observe other traffic or any obstacles in time to avoid collision.

Table 3: VMC Minima, according to AIP (AIRAC AMDT 07/21 Effective Date 09 SEP 2021)

5.13 Wreckage examination detailed description.

- In one forward seat, its mounting frame on the a/c is completely statically fractured in the horizontal plane. In the other front seat, its seat is completely detached from its support frame.
- The aft right position seat cushion has been dismantled, while biological material was also found where a DNA sample for analysis was collected. According to this analysis, the biological material belongs to the passenger.
- The frame of the rear seat cushion has been fractured as a result of the impact, while under the right seat, part of the frame is missing, Anx.5.11, Photo 21.
- The frame of the rear right seat back is fractured and deformed to the left, Anx.5.11, Photo 22.
- The indicated airspeed index was 119 kt and the fuel pressure was about 2.5 psi.