AIRCRAFT ACCIDENT

FINAL REPORT

A 03/23P

Air Accident Investigation Bureau (AAIB)

Ministry of Transport, Malaysia

Rotary Wing Helicopter Leonardo AW189

Registration 9M-BOF

at UniKL MIAT Hangar, Subang

on 22 July 2023

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Issued on 12 July 2024
MOT(S).600-5/4/97

FINAL REPORT A 03/23

AIR ACCIDENT INVESTIGATION BUREAU (AAIB)
MALAYSIA

REPORT NO.: A 03/23

OPERATOR	**: FIRE AND RESCUE DEPARTMENT OF MALAYSIA (FRDM)**
AIRCRAFT TYPE	**: LEONARDO AW189**
AIRCRAFT NATIONALITY	**: MALAYSIA**
REGISTRATION	**: 9M-BOF**
PLACE OF OCCURRENCE	**: UNIKL MIAT HANGAR, SUBANG**
DATE AND TIME	**: 22 JULY 2023 AT 1149LT**

The sole objective of the investigation is the prevention of accidents and incidents. In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of this investigation to apportion blame or liability.

All times in this report are Local Time (LT) unless stated otherwise. LT is UTC + 8 hours.

INTRODUCTION

The Air Accident Investigation Bureau of Malaysia

The Air Accident Investigation Bureau (AAIB) is the air accident and serious incident investigation authority in Malaysia and is responsible to the Minister of Transport. Its mission is to promote aviation safety through the conduct of independent and objective investigations into air accidents and serious incidents.

The AAIB conducts these investigations in accordance with Annex 13 to the Chicago Convention, the Civil Aviation Act of Malaysia 1969, and the Civil Aviation Regulations of Malaysia 2016.

It is inappropriate that AAIB reports should be used to assign fault or blame or determine liability since neither the investigations nor the reporting processes have been undertaken for that purpose.

In accordance with ICAO Annex 13 paragraph 4.1, notification of the accident was sent on 24 July 2023 to the Civil Aviation Safety Investigation Authority of the Italian State (ANSV) as the State of Design and Manufacture, and to the International Civil Aviation Organisation (ICAO). The Preliminary Report for this accident was subsequently submitted to the ASNV, ICAO, the Civil Aviation Authority of Malaysia (CAAM), and the aircraft operator on 24 August 2023.

In accordance with ICAO Annex 13 paragraph 6.3, a copy of the Draft Final Report was sent on 27 February 2024 to CAAM as the State of Registry, the ANSV as the State of Design and Manufacture, the Aircraft Operator, the Aircraft Maintenance Operator, and the Training Factory Area Operator inviting their significant and substantiated comments on the report.

Unless otherwise indicated, recommendations in this report are addressed to the investigating or regulatory authorities of the State having responsibility for the matters with which the recommendations are concerned. It is for those authorities to decide what action is to be taken.

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GLOSSARY OF ABBREVIATIONS

AAIB	Air Accident Investigation Bureau
AFRS	Airport Fire & Rescue Service
AIP	Aeronautical Information Publication
ANSV	Civil Aviation Safety Investigation Authority of the Italian State
ATC	Air Traffic Controller
CAAM	Civil Aviation Authority of Malaysia
CAD	Civil Aviation Directive
CAS	Caution Administration System
CCD	Charged-coupled device camera
CCTV	Closed-Circuit Television
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CPL	Commercial Pilot License
CVFDR	Cockpit Voice Flight Data Recorder
DGFD	Director General Flying Directives
EGR	Engine Ground Run
FRDM	Fire and Rescue Department of Malaysia
GAM	Galaxy Aerospace (M) Sdn Bhd
HFACS	Human Factors Analysis & Classification System
hrs	hours
KPKT	*Kementerian Perumahan dan Kerajaan Tempatan*
LT	Local Time
m	metre(s)
MIAT	Malaysian Institute of Aviation Technology
MOR	Mandatory Occurrence Reporting
MRO	maintenance, repair, and overhaul
OEM	Original Equipment Manufacturer
OJT	On-Job Training
PAC	Power Assurance Check
PGOU	*Pasukan Gerakan Operasi Udara*
PIC	Pilot in Command
PTZ	Pan, Tilt, and Zoom camera

Sdn Bhd	*Sendirian Berhad* (Private Limited)
STRIDE	Science and Technology Research Institute for Defence
TFA	Teaching Factory Area
UniKL	Universiti Kuala Lumpur
UTC	Coordinated Universal Time
WMSA	Sultan Abdul Aziz Shah Airport

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SYNOPSIS

A Leonardo AW189 helicopter bearing registration 9M-BOF was scheduled for a post-maintenance flight with seven (7) people on board at the Kuala Lumpur University – Malaysian Institute of Aviation Technology (UniKL MIAT) Subang Campus near Sultan Abdul Aziz Shah Airport (WMSA).

Before taking off, while taxiing, the helicopter spun to the left for no apparent reason before rolling over onto its right side. Despite the helicopter's significant damage, all of the passengers were able to evacuate with minor injuries.

The aircraft operator submitted a Mandatory Occurrence Report (MOR) to the CAAM, and AAIB as notification of the occurrence. An investigation team was dispatched on the same day.

1.0 FACTUAL INFORMATION

1.1 History of the Flight

On 22 July 2023, a Fire and Rescue Department of Malaysia (FRDM) flight crew from the Air Operations Centre (PGOU) was assigned to carry out an engine ground run (EGR) and flight test on a Leonardo AW189 helicopter (registration number 9M-BOF) belonging to their department, following the application made on 21 July 2023 by its maintenance, repair, and overhaul (MRO) organisation.

The initial EGR time was scheduled at 1000 LT that morning, but it had to be postponed to 1050 LT due to rain. Before carrying out the task, the Pilot in Command (PIC) gave a briefing to the flight crew involved regarding the tasks for that morning. After all pre-flight preparations were made, such as the flight plan, weight and balance, and weather report, the crew moved from their base to the aircraft hangar which is located in the vicinity of the Kuala Lumpur University – Malaysian Institute of Aviation Technology (UniKL MIAT) Subang Campus.

After arriving in UniKL MIAT at 1000 LT, the weather conditions still did not permit the crew to continue with the task and the PIC decided that the activity be suspended until the weather condition improved. At 1030 LT the weather condition gradually improved, and the aircraft was towed out from the hangar to the EGR location (Refer to Figure 1). The crew moved to the aircraft to carry out inspections and received a short briefing from the Chief Engineer regarding the tasks to be carried out. The total occupants on board were seven (7), being two (2) pilots, one (1) Quarter Master, one (1) Engineer in Charge (EIC), one (1) Engineer, one (1) Technician, and one (1) on-job training (OJT) student.

At 1050 LT, the first start-up was carried out until the aircraft testing was completed, then followed up with the EGR with the aim of obtaining a track balancing reading of the main rotor. Although the reading received was within the reading range, the Chief Engineer requested the flight crew to shut down the aircraft engine in order to make further adjustments or fine-tuning to the weight on the blade.

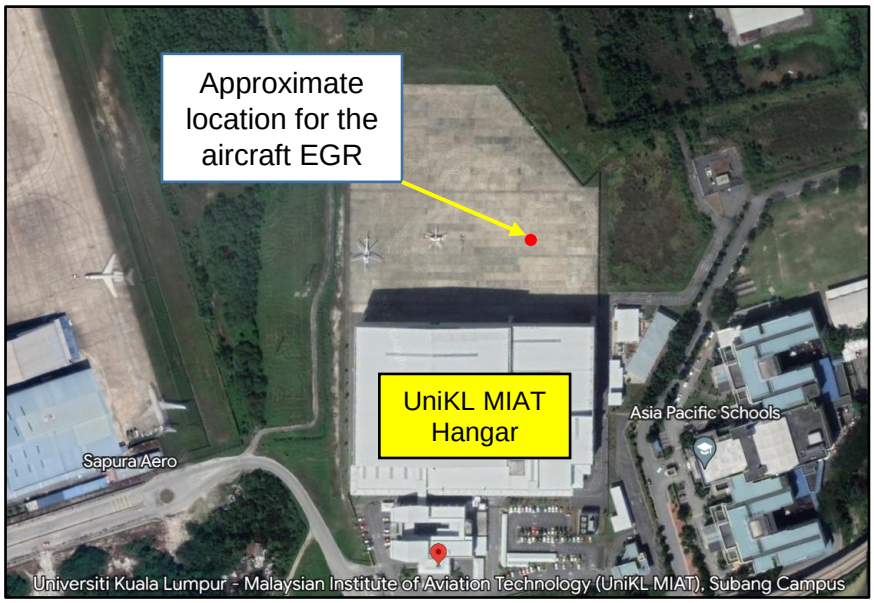


Figure 1: Aircraft location for EGR

(Map Source: Google Earth)

After completing the minor adjustment at 1140 LT, the flight crew carried out another aircraft check to ensure the aircraft was in good condition in preparation for the second EGR. The second start-up commenced and the Chief Engineer carried out his duties to obtain the readings. This time the reading received on the track balancing was better and the Chief Engineer instructed the flight crew to conduct a hover check at heights of seven (7) feet and seventy (70) feet.

Prior to executing the hover check, the co-pilot contacted the Air Traffic Controller (ATC) of Sultan Abdul Aziz Shah Airport (WMSA) and requested clearance to perform the hover check in the UniKL MIAT hangar area at the height of hundred (100) feet and below. After permission was obtained, the PIC taxied the aircraft to the hover test area for the execution of the Power Assurance Check (PAC) at the height of seven (7) feet.

While taxing to the hover test area, all of the aircraft perimeters were in normal condition until the aircraft arrived approximately 3m from the designated take-off and approach area, when the "Yaw Trim Failed" appeared on the CAS message, and the co-pilot made a call out to the PIC about the situation.

Immediately after receiving the caution warning, the PIC stopped the aircraft and informed the rest of the crew that he would make some corrections to the position of

the aircraft which was not lined up straight with reference to the desired hover position. The PIC moved the aircraft slightly forward to straighten the nose landing gear.

While the correction was being made, the aircraft suddenly spun to the left continuously and toppled. The PIC tried his best to control the spin but to no avail. After rotating for one and a half times, the helicopter rolled to the right, the main rotor blades hit the tarmac surface and stopped by itself, and the aircraft finally rested on its right-hand side (Refer to Figure 2).

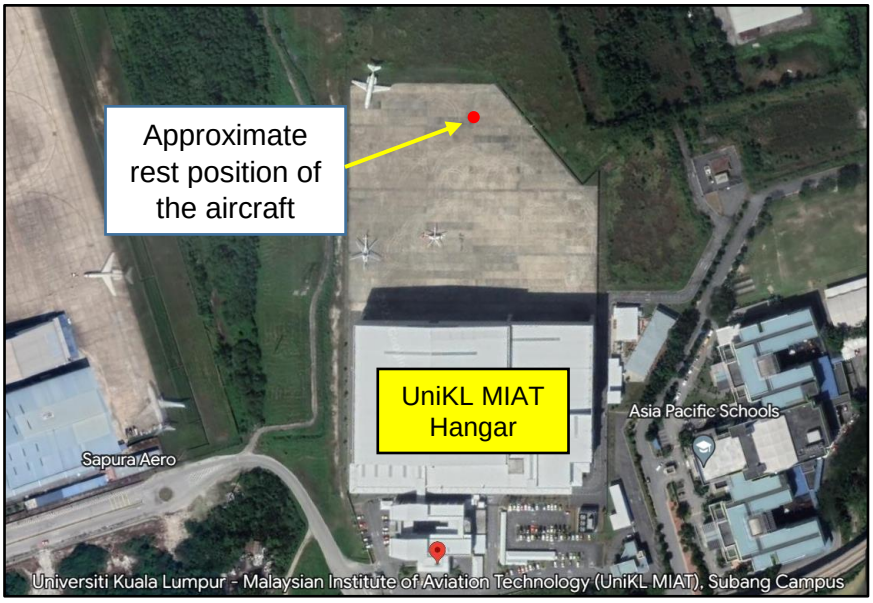


Figure 2: Aircraft's last resting position

(Map Source: Google Earth)

After the aircraft came to a rest, the co-pilot performed a complete shutdown and everyone vacated through the left side of the aircraft. Fortunately, everyone exited safely with minor injuries. All crew and passengers were taken to the hospital for immediate medical check-ups and a police report was made by the co-pilot later.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others	Total
Fatal	NIL	NIL	NIL	NIL
Serious	NIL	NIL	NIL	NIL
Minor/None	02	05	NIL	NIL

1.3 Damage to Aircraft

A general visual inspection was carried out to assess and identify the damage to the aircraft after the occurrence.

1.4 Other Damage

There was no other damage to any objects or facilities other than the aircraft.

1.5 Personnel Information

1.5.1 Pilot 1

Status	Pilot in Command (PIC)
Nationality	Malaysian
Age	42 years old
Gender	Male
License Type	CPL 3802/H
License Validity	Valid until 30 September 2023
Aircraft Rating	AW189
Instrument Rating	Valid until 30 September 2023
Total Hours on Type	774hrs
Total Flying Hours	1820:5hrs
Rest Period Since Last Flight	More than 72hrs
Medical Certificate Class	1
Medical Expiry Date	30 November 2023

1.5.2 Pilot 2

Status	Co-Pilot
Nationality	Malaysian
Age	38 years old

Gender	Male
License Type	CPL 6419/H
License Validity	Valid until 30 April 2024
Aircraft Rating	AW189
Instrument Rating	Valid until 30 June 2024
Total Hours on Type	1025:8hrs
Total Flying Hours	1187:3hrs
Rest Period Since Last Flight	More than 72hrs
Medical Certificate Class	1
Medical Expiry Date	31 August 2023

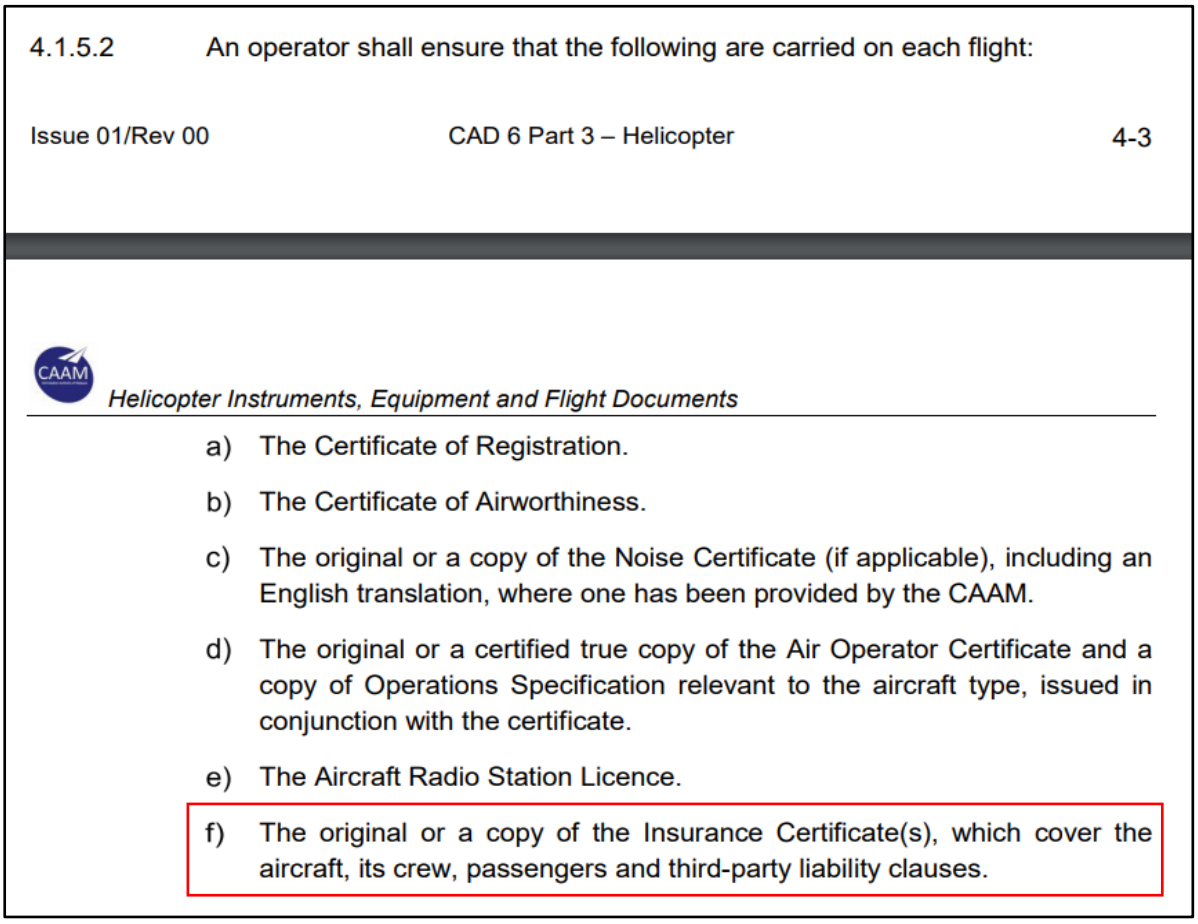
1.6 Aircraft Information

Aircraft Type	Leonardo AW189
Manufacturer	Leonardo
Year of Manufacturer	2018
Owner	Fire and Rescue Department of Malaysia (FRDM)
Registration No.	9M-BOF
Aircraft Serial No.	49053
C of A Expiry Date	17 July 2024
C of R Expiry Date	01 March 2024

The aircraft had a prolonged period of inactivity due to ongoing maintenance of the aircraft by the maintenance operator from 24 March up to 21 July. On 21 July, a total of eight ground runs were performed. It has a valid registration, and Certificate of Airworthiness (C of A) and has been maintained in compliance with the regulations. The maintenance records indicated that the aircraft was equipped, and maintained in accordance with existing regulations and approved procedures.

1.6.1 Insurance Certificate

The aircraft is a civil registered aircraft; therefore, it is subject to civil aviation rules and regulations, under the category of general aviation operation[1]. The Civil Aviation Directives 06 (CAD 06) Part 03 – HELICOPTER Section III – General Aviation, paragraph 4.1.5.2 states that an operator shall ensure that the following are carried on each flight: The original or a copy of the Insurance Certificate(s), which cover the aircraft, its crew, passengers and third-party liability clauses (refer to Figure 3 below).



4.1.5.2 An operator shall ensure that the following are carried on each flight:

Issue 01/Rev 00 CAD 6 Part 3 – Helicopter 4-3

Helicopter Instruments, Equipment and Flight Documents

a) The Certificate of Registration.

b) The Certificate of Airworthiness.

c) The original or a copy of the Noise Certificate (if applicable), including an English translation, where one has been provided by the CAAM.

d) The original or a certified true copy of the Air Operator Certificate and a copy of Operations Specification relevant to the aircraft type, issued in conjunction with the certificate.

e) The Aircraft Radio Station Licence.

f) The original or a copy of the Insurance Certificate(s), which cover the aircraft, its crew, passengers and third-party liability clauses.

Figure 3: CAD 06 Part 03 – HELICOPTER Section III – General Aviation

However, there was no evidence of any insurance certificate being carried on board the aircraft. Upon further investigation, it was found that the aircraft was not insured, as well as an absence of coverage for the third-party liability if the accident were to involve damage, injury, or death to a third party.

[1] **General aviation operation** means an aircraft operation other than a commercial air transport operation or an aerial work operation – MCAR 2016

1.7 Meteorological Information

Rain was reported early in the day. Nevertheless, the weather conditions on that day did not contribute to the occurrence of the event.

1.8 Aids to Navigation

Not applicable.

1.9 Communications

All communication frequencies were operating normally.

1.10 Aerodrome Information

The location of the accident is not in an aerodrome neither part of the aerodrome, and there is no aeronautical information available for the facility. The accident happened in an area called the Teaching Factory Area (TFA) (broken yellow line illustrated in Figure 4) and it is located within the vicinity of UniKL MIAT Subang Campus (thick yellow line).

1.10.1 Safety Observations of the Teaching Factory Area (TFA)

While on the scene, the investigation team observed that there were several safety hazards around the TFA where the aircraft was operating. Referring to Figure 4, the areas marked by the red squares represent safety hazards to aircraft operation.

Figure 4: UniKL MIAT Subang Campus
(Map Source: Google Earth)

The red square on the left indicates high-voltage power lines and pylons that are approximately 28 to 30m in height along the left-hand (southern) side of the TFA. Thus, helicopters operating there have only one way in and one way out from the right-hand (northern) side of the TFA. The other red square on the right contains the National Shooting Range Subang, which is a safety hazard to flying operations due to firearms shooting activities. There were also numerous tall trees averaging from 10 to 30m in height observed around the TFA which could hinder aircraft approaches and landings. There was also a water retention area located near the facility directly below the take-off and landing path of the operating aircraft from the TFA.

It is also important to highlight that the TFA has neither any taxiways nor road access connecting it to the WMSA aerodrome's airside located nearby across the western edge of the TFA. In the event of any calamity, it will be difficult for the first responders such as the Airport Fire and Rescue Service (AFRS) and other emergency services to arrive at the scene expeditiously.

In summary, there are serious safety concerns in and around the TFA. The identified hazards above jeopardise the safety of aircraft operating in and out of the area. While it is the responsibility of the FRDM's Authorising Officer (as stipulated in the FRDM's DGFD) to consider the potential hazardous factors at the departure or destination, it is also the responsibility of the maintenance operator at the TFA to put in place the necessary safety mechanisms to mitigate these safety hazards. Aircraft operation in such a hazardous environment is very risky, particularly where there is no evidence of any adequate risk control and mitigation measures to ensure safe operation.

1.11 Flight Recorders

The aircraft was equipped with a Cockpit Voice and Flight Data Recorder (CVFDR) that was impounded by the investigation team and sent to the AAIB's Flight Recorder Laboratory for analysis. Details of the CVFDR are shown in the table below.

Type or Recorder	Multi-Purpose Flight Recorder
Part No.	D51615-142 Iss 02
Serial No.	A 12033-007
Manufacturer	Penny and Giles Aerospace Ltd.

Manufactured Date	June 2015
S/W Reference	SW110522
Supply	28Vdc 12W Max.
Weight	3.26kg Max. (Dual Power Input)

The flight data downloaded from the CVFDR were verified and found to be compatible with the flight data obtained from the aircraft manufacturer. Therefore, two separate sets of flight data are available as evidence to support and substantiate the findings raised in this report. The result of the data analysis is presented in Chapter 2.

1.12 Wreckage and Impact Information

Figure 5 below provides a general description of the accident site, the initial aircraft's EGR location, the taxi path taken by the aircraft, and the location of the aircraft wreckage. The 'big red dot' indicates the EGR location, the 'broken black line' is the taxi route, the 'broken yellow line circle' illustrates the aircraft debris distributions, and the 'yellow line circle' shows the main wreckage.

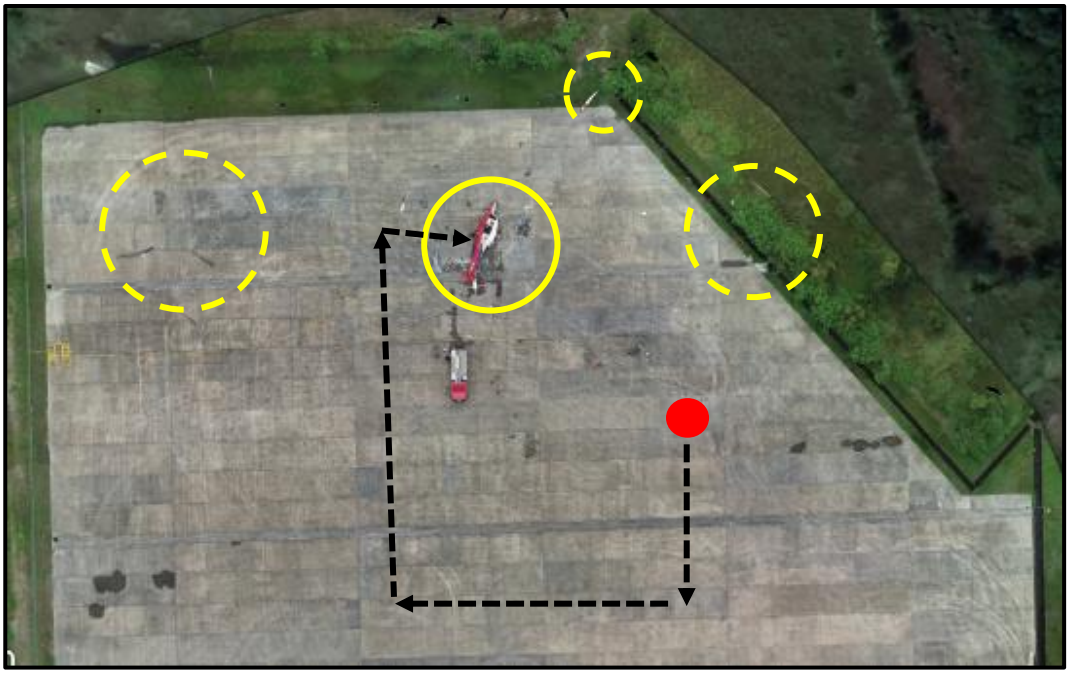


Figure 5: 9M-BOF General Map of The Incident
and Wreckage Distribution

Figure 6: Photographs of 9M-BOF Wreckage

1.13 Medical and Pathological Information

Both pilots underwent a urine drug panel screen and the results were negative for substance abuse. The result of the blood alcohol screening was within the normal limits.

1.14 Fire

There was no evidence of fire before or after the impact.

1.15 Survival Aspects

All the flight and maintenance crew onboard were securely strapped in at their respective seats when the accident happened. After the aircraft had stopped spinning completely and rolled over on its right-hand side with the cabin and fuselage still intact, and as soon as the PIC had completed the shutdown of the engines, all occupants evacuated the aircraft by climbing through the left-hand side door and exited the

aircraft safely. Upon noticing the accident, the maintenance crew on the ground immediately rushed towards the aircraft with several portable fire extinguishers and assisted in the evacuation of the victims.

1.16 Tests and Research

The aircraft fuel, hydraulic oil, and gearbox oil samples were sent to the Science and Technology Research Institute for Defence (STRIDE) for tests. The tests found all the samples to be bright and clear, free from undissolved water, with some sediments observed. The test results were within the parameters without the detection of any abnormalities that could have possibly contributed to the accident.

1.17 Organisational and Management Information

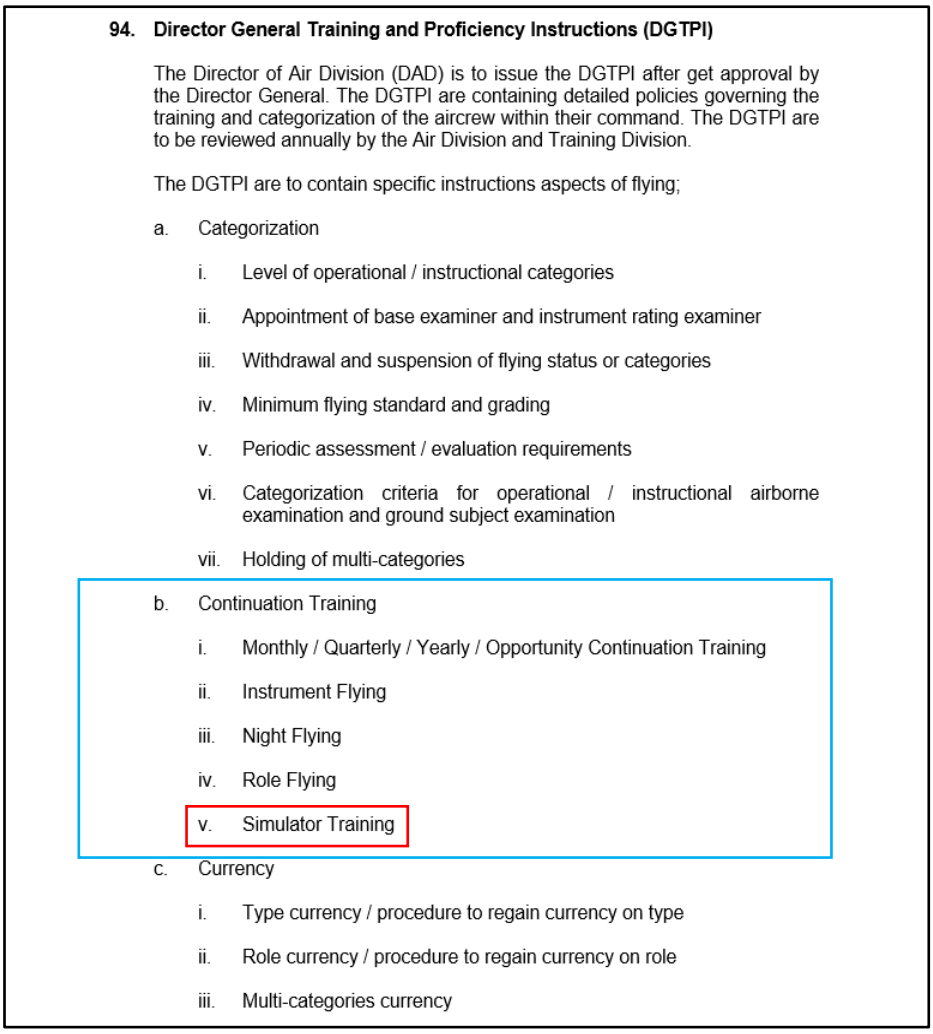
1.17.1 Aircraft Operator

The aircraft operator is the FRDM, a government agency under the Ministry of Housing and Local Government (KPKT). The establishment provides fire prevention and extinguishing services, enforces laws related to safety and firefighting aspects, and provides humanitarian aid services. FDRM provides professional fire and rescue services to save lives, property, and the environment, as well as to increase the level of fire safety and public awareness.

In 1998, the FRDM acquired two helicopters and started the Fire Air Unit. Presently, the FRDM has rotary-wing fleets with five types of aircraft in service, including the Leonardo AW189. Since the Department is not a Maintenance Approval Organisation (CAAM Part 145), all aircraft are maintained by aircraft MRO organisations that possess the Maintenance Approval Organisation (CAAM Part 145). Their AW189 fleet is maintained by Galaxy Aerospace Malaysia (M) Sdn Bhd.

1.17.1.1 Simulator Training

The investigation found that the FRDM had never sent their AW189 pilots for recurrent flight simulator training. The only time the pilots had attended flight simulator training was during their initial type conversion training. This was not compliant with the stipulation in the Director General Flying Directives (DGFD, Directive 94(b) and Directive 101(d)) as illustrated in Figure 7 and Figure 8.



94. Director General Training and Proficiency Instructions (DGTPI)

The Director of Air Division (DAD) is to issue the DGTPI after get approval by the Director General. The DGTPI are containing detailed policies governing the training and categorization of the aircrew within their command. The DGTPI are to be reviewed annually by the Air Division and Training Division.

The DGTPI are to contain specific instructions aspects of flying;

a. Categorization

i. Level of operational / instructional categories

ii. Appointment of base examiner and instrument rating examiner

iii. Withdrawal and suspension of flying status or categories

iv. Minimum flying standard and grading

v. Periodic assessment / evaluation requirements

vi. Categorization criteria for operational / instructional airborne examination and ground subject examination

vii. Holding of multi-categories

b. Continuation Training

i. Monthly / Quarterly / Yearly / Opportunity Continuation Training

ii. Instrument Flying

iii. Night Flying

iv. Role Flying

v. Simulator Training

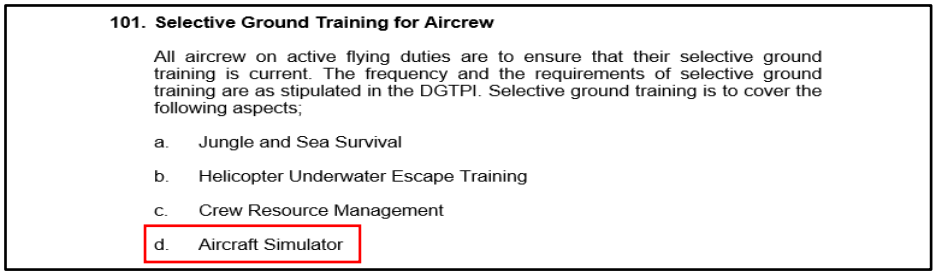
c. Currency

i. Type currency / procedure to regain currency on type

ii. Role currency / procedure to regain currency on role

iii. Multi-categories currency

Figure 7: Directive 94(b), DGFD



101. Selective Ground Training for Aircrew

All aircrew on active flying duties are to ensure that their selective ground training is current. The frequency and the requirements of selective ground training are as stipulated in the DGTPI. Selective ground training is to cover the following aspects;

a. Jungle and Sea Survival

b. Helicopter Underwater Escape Training

c. Crew Resource Management

d. Aircraft Simulator

Figure 8: Directive 101(d), DGFD

Recurrent flight simulator training is a critical aspect of maintaining and enhancing the skills and knowledge of pilots. It is important because flying an aircraft is a complex task that requires a combination of cognitive, motor, and decision-making skills. Recurrent simulator training helps pilots keep their skills sharp, ensuring they can effectively handle the aircraft in various situations.

It allows pilots to practice and reinforce emergency procedures in a safe and controlled environment. The pilots can simulate engine failures, system malfunctions, and other critical scenarios, ensuring they know how to react appropriately when facing such challenges in real flight.

Recurrent training can be performed in a real aircraft itself. However, there are limits to how many times a specific procedure or manoeuvre can be repeated, especially in busy operational environments. Additionally, training in a real aircraft also involves the inherent risks associated with flying, particularly for simulations to practice aircraft emergencies procedures and irregular operations.

In summary, recurrent flight simulator training is essential for pilot proficiency, safety, and regulatory compliance. It allows pilots to maintain their skills, practice emergency procedures, and adapt to new challenges in a controlled and cost-effective environment, ultimately contributing to safer and more competent aviation operations.

1.17.2 Maintenance Operator

Galaxy Aerospace Malaysia (M) Sdn Bhd is the maintenance organisation responsible for the maintenance of the FRDM's AW189 fleet. It is an MRO organisation approved by Malaysian civil and military authorities to provide aircraft maintenance, component maintenance, and airworthiness-related services. Their clients range from government agencies, airlines, VVIP owners, OEMs, and general aviation clients including operators from neighbouring countries.

Galaxy Aerospace Malaysia headquarters office is located in Ara Damansara, Petaling Jaya. Selangor, while the operations centre is placed at the MRO Centre within the TFA at the UniKL MIAT Subang Campus.

1.17.3 Teaching Factory Area (TFA) Operator

After the UniKL main campus situated in Sepang, Selangor, the UniKL MIAT Subang Campus was established near the WMSA airport, Selangor in 2017 to meet the increasing training demand of the aviation industry.

There are various facilities available at the UniKL MIAT Subang, and among them is the hangar that is in the TFA as illustrated in Figure 3. All buildings and facilities on

this campus are jointly maintained and managed between UniKL MIAT and UniKL Resources Sdn Bhd, another subsidiary company under UniKL. The hangar and the TFA are currently utilised by the tenants that are working together with UniKL MIAT, which among them is Galaxy Aerospace Malaysia (M) Sdn Bhd.

It should be emphasised that the MIAT hangar and TFA are not within the designated aerodrome area of WMSA and is also not part of the scope of certification of WMSA. The published Aeronautical Information Publication (AIP) of WMSA also does not indicate the existence of the hangar and TFA.

As the owner of the facility, UniKL MIAT claimed that discussion-based sessions were held with its tenants to smoothen their daily/weekly operation and administration. However, there was no evidence of any record of the minutes of these meetings.

1.17.3.1 Closed-Circuit Television (CCTV) and Windsock

The MIAT hangar facility and TFA are equipped with CCTVs, namely Charged-Coupled Device (CCD) cameras and Pan, Tilt, and Zoom (PTZ) cameras. The CCTVs provide camera footage for crime prevention, evidence on handling disputes, monitoring staff, and visibility of entire business premises, among other purposes.

During the investigation, it was found that most of the CCTVs were inoperative, including the one located right in front of the area where the accident happened. Thus, the investigation team was unable to obtain a close, clear, and good-quality video recording of the accident. Nevertheless, the investigation team managed to obtain footage from one of the CCTV located inside Hangar 1. Although the footage was not of high quality, it was clear enough to provide the investigators with visual evidence of the sequence of events leading to the occurrence of the accident.

There was a total of 34 CCTV units installed within the facility – 7 PTZ units and 27 CCD units. Out of these 34 units, only 8 units (2 PTZs and 6 CCDs) were operative, while the other 26 units were inoperative.

The TFA is also provided with a windsock. A windsock is a conical textile tube that is used at airports, helipads, and other locations to indicate the direction and strength of the wind, providing visual information to pilots, air traffic controllers, and ground

personnel. It plays a vital role in maintaining safety and efficiency in aviation and other areas where wind conditions are significant.

During the investigation, it was observed that the windsock at the TFA was left with the pole only, without any windsock as shown in Figure 9. The absence of a proper windsock in the TFA that is surrounded by vertical obstructions of substantial height, as noted earlier n this report, is hazardous to flight operation due to the unavailability of any actual wind direction and speed indications to aide safe manoeuvring by pilots in such a confined area.

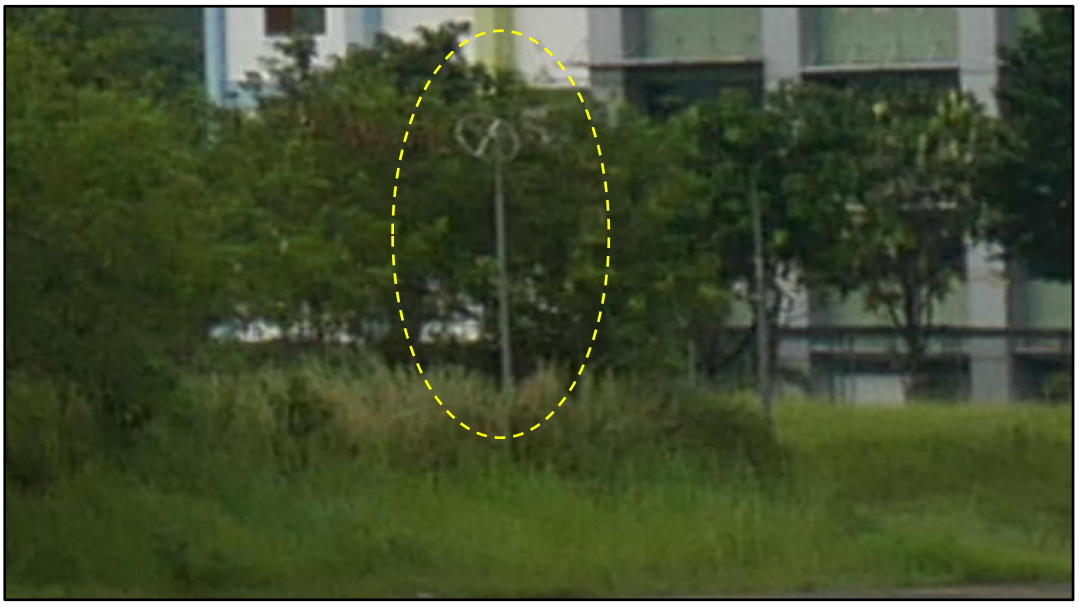


Figure 9: Windsock Pole Without the Windsock

In summary, the CCTVs and the windsock should have been maintained in good working conditions to ensure the safety of operation and security of the facility, its tenants, and the TFA operator itself. This function should be placed under the responsibility of a qualified Safety Officer appointed by the facility provider.

1.17.3.2 Safety Officer

It was brought to the investigation team's attention that the Safety Officer appointment had not been filled up for a prolonged period to oversee the organisation's safety and security-related matters. This may have led to poor safety management at the TFA, which explains why the majority of the CCTVs were inoperative and a serviceable windsock was unavailable. Since the last person assigned to oversee safety and

security matters has departed the company, the Safety Officer position has been left vacant for an extended period.

Qualified and certified Safety Officers are essential for maintaining a safe, secure, and healthy working environment, preventing accidents, and ensuring compliance with safety laws and regulations. Their work contributes to the well-being of individuals, the protection of property, and the overall success of organisations.

1.18 Additional Information

1.18.1 Carriage of On-Job Training (OJT) Personnel

As mentioned earlier, there were seven (7) occupants on board during the particular flight, which were two (2) pilots, one (1) Quarter Master, one (1) Engineer in Charge (EIC), one (1) Engineer, one (1) Technician, and one (1) OJT student. Although there was no task card or specific/recorded task for the OJT student to perform on the flight, the engineer had acquired verbal approval from the PIC to bring the OJT student on board the aircraft as an observer.

The authorisation was given by the PIC after the PIC informed the Base Commander of the engineer's request. Nonetheless, paragraph 45 in the DGFD states that passengers are not to be carried in FRDM aircraft during a functional check flight (CFC) (Refer to Figure 10).

45. Occasions When Passengers Are Not to Be Carried

Passengers are not to be carried in FRDM aircraft during the following occasions:

a. Formation flight

b. Air-to-air exercises of any type

c. Air-to-ground exercises of any type

d. Functional Check Flight

When it is essential for personnel to be carried in FRDM aircraft on occasions mention above, they are not to be authorization as supernumerary crew. Supernumerary crew must be medically fit for flight proposed.

Figure 10: Directive 45 (d), DGFD

1.19 Useful or Effective Investigation Techniques

Closed-circuit television (CCTV) footage, the CVFDR data analysis, and the Human Factors Analysis and Classification System (HFACS) were used to establish the contributing factors as well as the probable cause of this event.

1.19.1 Reason's "Swiss Cheese" Model

The Reason "Swiss Cheese" Model (Figure 11) is used to describe the layers of defences at which active failures/conditions and latent failures/conditions may occur in this event. Based on the evidence examined, it is determined that this mishap is Human Factor related.

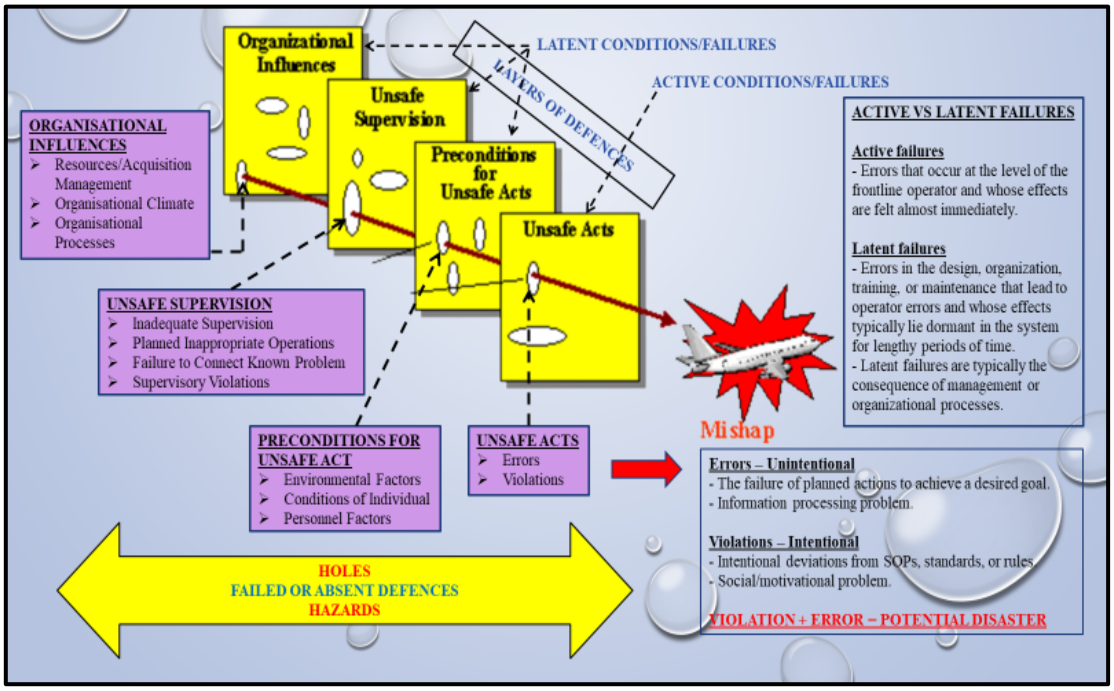


Figure 11: Reason's 'Swiss Cheese' Model Aviation

1.19.2 Human Factors Analysis and Classification System (HFACS)

HFACS is used to evaluate and establish or eliminate the various preconditions that resulted in the unsafe acts based on the described layers of defences in the Swiss Cheese model, at which active failures/conditions and latent failures/conditions may have occurred in this event. The supervisory and subsequent organisational difficulties that contributed to the prerequisite will then be evaluated. Finally, as shown in Figure 12, this provides a complete human factors picture of all the events that led up to the mishap.

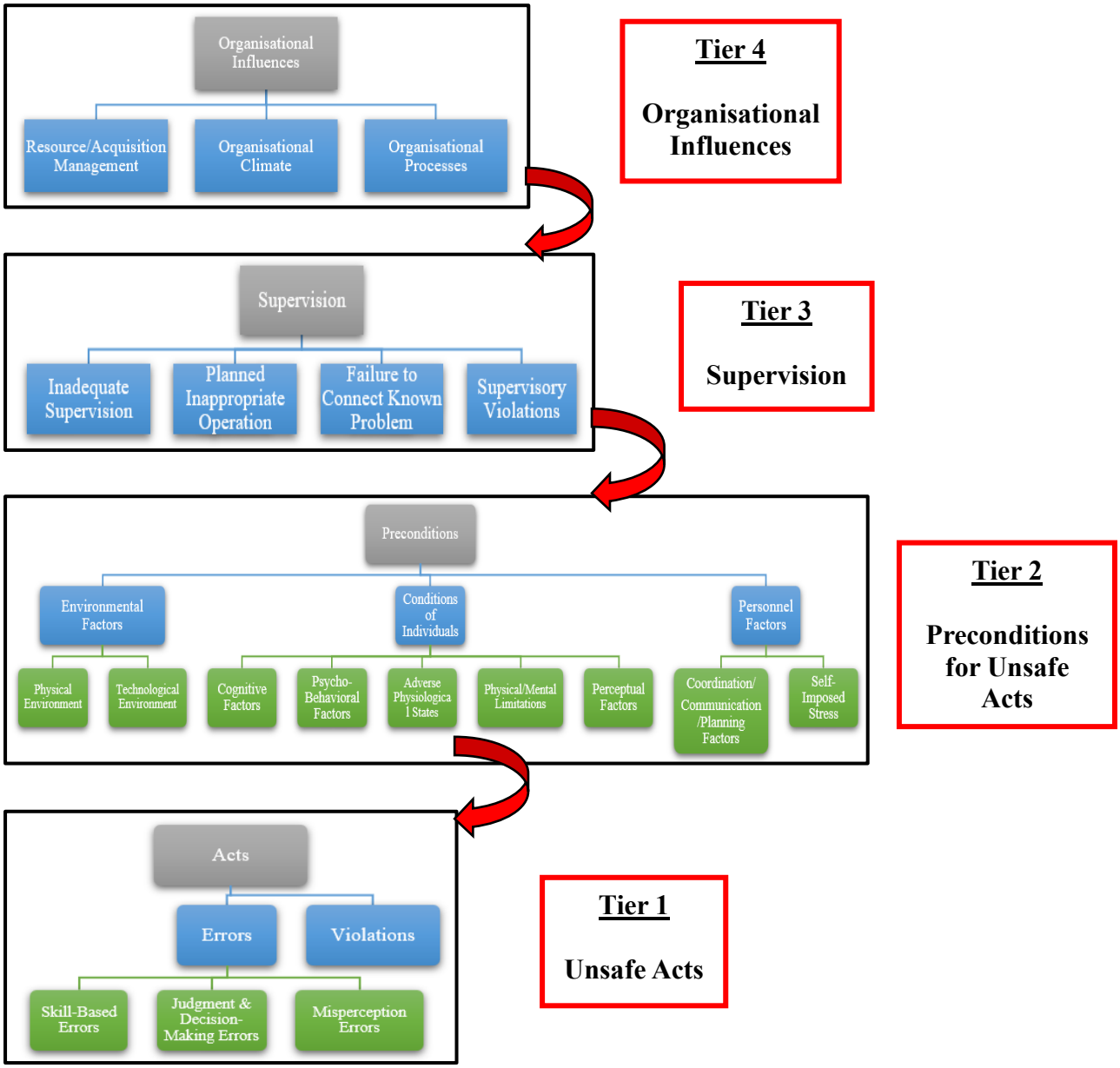


Figure 12: HFACS Model

2.0 ANALYSIS

2.1 CCTV Footage

The TFA and the hangar were installed with surveillance cameras that were able to record the accident sequence. The video footage obtained includes the recording of all the pre-flight activities and the subsequent helicopter rollover. In the last portion of the video footage, it was possible to observe the final right rotation of the aircraft. Despite the limited quality of the video, it is clear that the nose wheel was not in a centred position when the aircraft completed the right turn and came to a stop (Figure 13).

Figure 13: Video footage obtained from a CCTV

This evidence explains the reason why the aircraft did not immediately start to rotate on the left when the crew applied the left pedal at time T = 03:49:10 (refer to the diagrams below). In the off-centred condition, the nose wheel could have counteracted the left rotation, therefore requiring more tail rotor thrust than necessary for a centred (neutral) nose wheel position.

2.2 CVFDR Analysis

The provided CVFDR data includes the last twenty-five (25) flight hours of operation and two (2) hours of audio recording. The dataset covered the time frame from 6 March

2023 to 22 July 2023, which was the day of the accident. The data shows a prolonged period of inactivity from 24 March up to 21 July. On 21 July, a total of eight (8) ground runs were performed.

On the day, an initial ground run was conducted at T = 02:53 during which the Auto Pilot (AP) test was successfully completed. The aircraft was then shut down nine (9) minutes later at 03:02. The FDR started to record again at T = 03:40 when a new engine start procedure was initiated. The aircraft was seated with the nose wheel unlocked and the parking brakes engaged. The APU was active and the crew proceeded to start Engine No. 1 which stabilised at idle speed (55% Nr) about 40 seconds later. The recorded data highlighted that after stabilising Engine No.1, the crew proceeded to perform a cranking on Engine No. 2. This procedure was in accordance with the applicable RFM which requires performing an engine cranking if the pre-start ITT is above 150°C. Prior to the cranking, the recorded engine No. 2 ITT indication was slightly above 170°C.

Once the cranking was completed, the related engine ITT was decreased to 118°C, before the crew proceeded to the engine start. The No. 2 engine start was completed without any anomalies. Both the engines were stabilised at the idle speed (73% Nr), and few seconds later both were set in flight condition. Subsequently, the APU was shut down.

As depicted in the diagrams below, at T = 03:47:40 the crew activated both the Autopilot (AP) channels and immediately deactivated the parking brakes. At T = 03:47:50 the collective Force Trim Release (FTR) switch was activated and the PIC started to gently raise the collective control. The control increased up to 20% in 2 seconds and was kept in position for about 3 seconds when the PIC progressively applied the right pedal while reducing the collective to the Minimum Pitch on Ground (MPOG). The pedal displacement was observed in the range of about 37% in a 3-second timeframe.

As a consequence of the right pedal input, the aircraft started to rotate to the right reaching a maximum yaw rate of about 7°. The rotation continued for about 55 seconds when all the controls were returned to their neutral position – at this time the aircraft had rotated approximately 170°.

After a few more seconds at T = 03:48:55, a new right pedal input was observed – the pedal position went from 36% to 15% in about 3 seconds while maintaining a full down collective position. The pedal movement was not associated with the FTR activation which suggests that the input was commanded by the PIC acting against the pedal feel spring (DET).

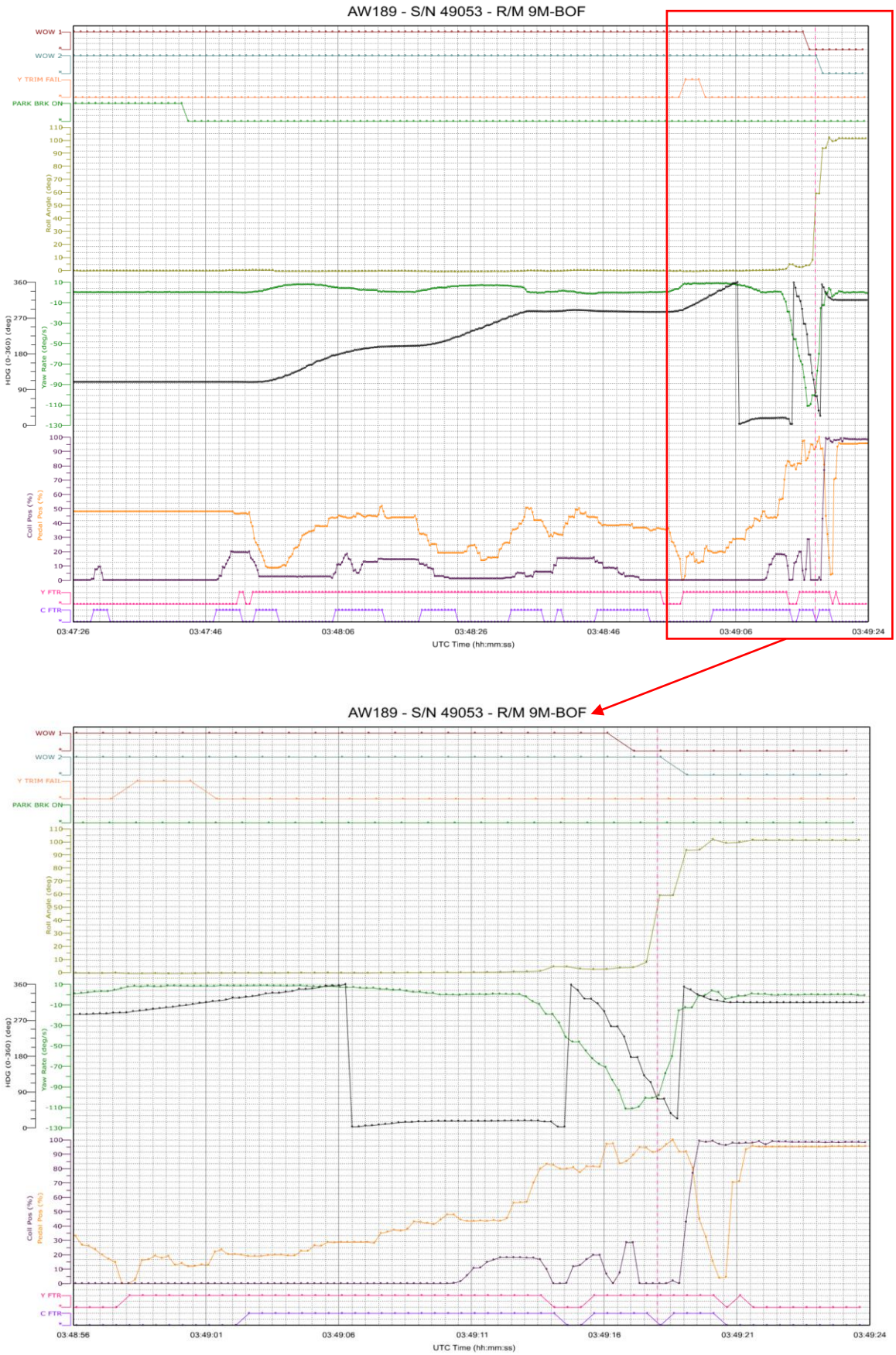
Approaching the 15% pedal position, the recorded data shows a step input down to 0% in a quarter of a second. This input took place in conjunction with the activation of the pedal FTR switch and the Y TRIM FAIL caution message, which remained active for about 2 seconds. The aircraft then began to rotate to the right in accordance with the pedal input; the yaw rate increased up to 8° and was kept almost constant with subsequent pedal adjustments. About 13 seconds after the pedal input and having completed a further 90° right rotation, the aircraft came to a stop.

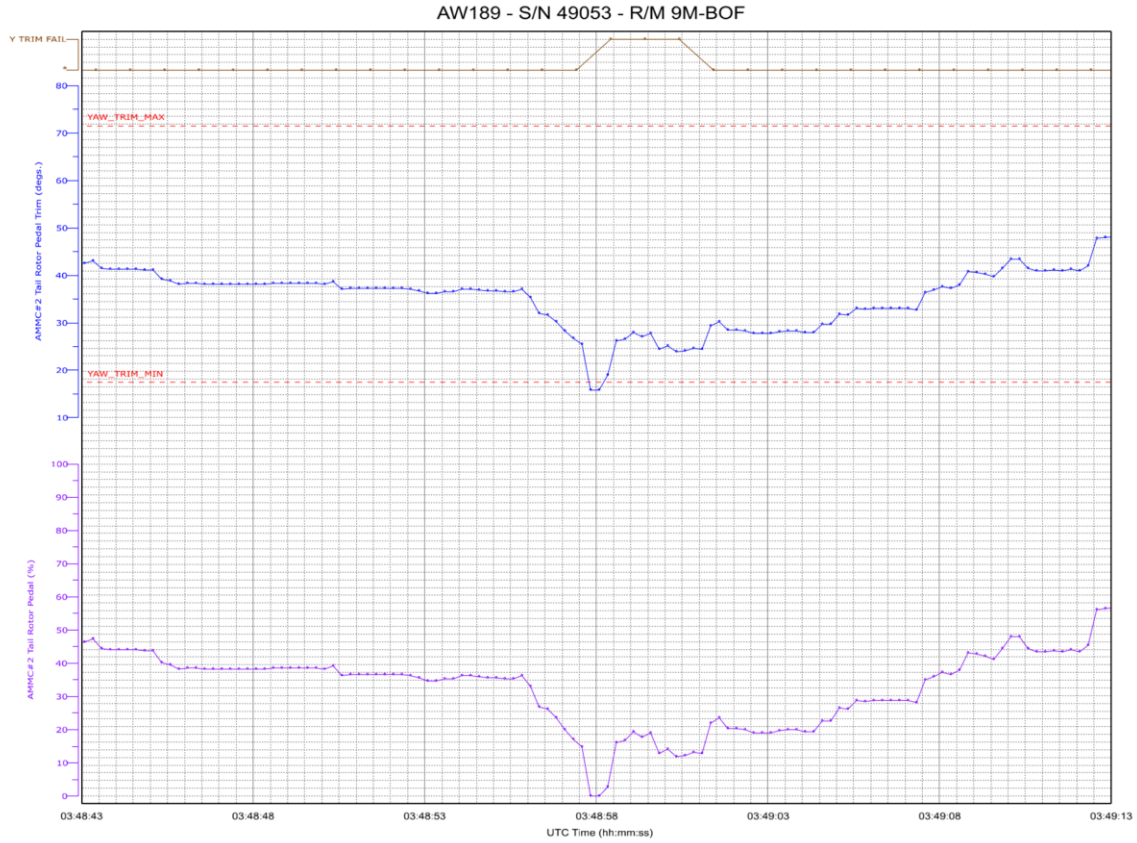
At T = 03:49:10, the PIC started to increase the collective up to 18% while maintaining the pedal almost centred (43%). The collective was maintained at a constant value and an initial left pedal input was recorded up to 56% resulting in a very limited yaw rate (2°). In the subsequent 2 seconds, the pedal was further moved to the left reaching the maximum value of 83%, the yaw stabilisation system reacted accordingly in order to reduce the developing yaw rate, which rapidly reached and exceeded 20°.

The collective control was rapidly reduced with no reduction of the pedal that remained almost at a constant value. The yaw rate continued to increase up to 45° when the flight data recorder highlighted the large and uncoordinated movement of the cyclic control mainly on the lateral axis.

Meanwhile, the left rotation speed continued to increase, and the aircraft rolled slightly on its right side. About 3 seconds after the first pedal input, the yaw rate indication was exceeding 110°, while the roll attitude was still below 10°. The subsequent cyclic inputs, mainly right and forward resulted in a rapid roll to the right, and when reaching 50° the main rotor blades went in contact with the ground.

The aircraft rotation progressively reduced but this did not prevent the aircraft from rolling over. The aircraft rested on its right-hand side and the crew proceeded to an emergency engine shutdown.


AW189 - S/N 49053 - R/M 9M-BOF
WOW 1
WOW 2
Y TRIM FAIL
PARK BRK ON
Roll Angle (deg)
HDG (0-360) (deg)
Yaw Rate (deg/s)
Coll Pos (%)
Pedal Pos (%)
Y FTR
C FTR
03:47:26
03:47:46
03:48:06
03:48:26
03:48:46
03:49:06
03:49:24
UTC Time (hh:mm:ss)
AW189 - S/N 49053 - R/M 9M-BOF
WOW 1
WOW 2
Y TRIM FAIL
PARK BRK ON
Roll Angle (deg)
HDG (0-360) (deg)
Yaw Rate (deg/s)
Coll Pos (%)
Pedal Pos (%)
Y FTR
C FTR
03:48:56
03:49:01
03:49:06
03:49:11
03:49:16
03:49:21
03:49:24
UTC Time (hh:mm:ss)



In summary, during the final ground rotation, the PIC was actively acting on the flight controls, and the aircraft response was always in accordance with the recorded inputs. The observed temporary activation of the Y TRIM FAIL caution message, prior to the last 90° rotation to the right, is not considered to be a contributing factor to the subsequent loss of control of the aircraft .

The caution message could have been related to the yaw trim being out of tolerance. The applicable rigging procedure requires that the yaw trim resolver transducer limits must stay within 71.5 ± 2° (Full Left = 100%) and 17.5 ± 2° (Full Right = 0%). The analysis highlighted that when the pilot applied the full right pedal, the trim readout was slightly below the minimum allowed value, thus likely causing the activation of the related caution message.

The ground rotation was performed by the pilot using the control technique where an initial collective input was applied to lighten the aircraft on its wheels and a subsequent pedal input in the direction of the desired rotation. Once the rotation was initiated, the pilot reduced the collective to MPOG and controlled the rotation rate acting mainly on the pedal control.

During the final left rotation, the analysis highlighted that the initial left pedal input when light on wheel did not generate any significant left yaw, possibly due to the not properly centred position of the nose wheel. Further left pedal input by the pilot had then caused the rapid rotation of the nose wheel and a very sudden increase in the yaw rate that led to the subsequent loss of control.

2.3 Human Factor Analysis

Human factor issues related to this accident were examined using the Reason's Swiss Cheese model and HFACS worksheet. From the HFACS worksheet, evidence statements are provided for ratings of 2, 3, and 4 as shown in paragraphs 2.3.1 to 2.3.4. The series of latent failures outlined in paragraph 2.2 that led to the unsafe acts which breached the safety barriers and ultimately caused the mishap are revealed in paragraphs 2.3.1 to 2.3.4. Subsequently, an Investigation Analysis Summary is tabulated in paragraph 2.4.

2.3.1 Tier 1 – Unsafe Acts

AE	ERRORS	EVIDENCE
AE 1	**Skill-Based Errors**	
AE 1.4	**Over-Control/Under-Control.** Over-control/Under-control is a factor when an individual responds inappropriately to conditions by either over-controlling or under-controlling the aircraft/vehicle/system. The error may be a result of preconditions or a temporary failure of coordination	The initial left pedal input when light on wheel did not generate any significant left yaw, possibly due to the not properly centred position of the nose wheel. Further left pedal input by the PIC caused the rapid rotation of the nose wheel and a very sudden increase in the yaw rate that led to the subsequent loss of control.

Unsafe acts are those that are most closely tied to the mishap and can be described as active failures or actions committed that result in human error or unsafe situations. These active failures or actions are identified as Errors and Violations.

Unaware of it at the time, the nose wheel's improper centring (as shown in Figure 13) may have prevented the PIC's first left pedal input from producing any discernible left

yaw in this instance. The nose wheel then quickly rotated as a result of the additional left pedal input, which also abruptly increased the yaw rate and resulted in the following loss of control.

2.3.2 Tier 2 – Preconditions for Unsafe Acts

PC	CONDITIONS OF INDIVIDUAL	EVIDENCE
PC 1	**Cognitive Factors**	
PC 1.6	**Distraction.** Distraction is a factor when the individual has an interruption of attention and/or inappropriate redirection of attention by an environmental cue or mental process that degrades performance.	"Yaw Trim Failed" appeared on the CAS message and a call-out was made by the co-pilot during taxiing just before reaching the hover test area, however, the presence of this factor didn't cause the accident but likely caused the aircraft's heading to be slightly off to the right when it stopped.
PC 5	**Perceptual Factors**	
PC 5.4	**Misperception of Operational Conditions.** Misperception of Operational Conditions is a factor when an individual misperceives or misjudges altitude, separation, speed, closure rate, road/sea conditions, aircraft/vehicle location within the performance envelope or other operational conditions and leads to an unsafe situation.	Failing to correctly sense the actual nose wheel position by the PIC while repositioning the aircraft before the aircraft spun.

The breach in the precondition for the unsafe act defence layer is a combination of cognitive and perceptual factors which had contributed to the unsafe act as analysed in paragraph 2.3.2. The CAS message that appeared indicating the "Yaw Trim Failed" during the final turn just before stopping the aircraft might have created distraction or interruption to the pilot. The distraction might have resulted in the aircraft's heading being slightly off to the right when it stopped, and requiring correction by the PIC to straighten the aircraft's position.

This cognitive factor is further escalated by the PIC's misperception of the position of the nose wheel which the PIC thought it was off only slightly to the right. Based on that perception, the PIC applied only a slight input to the left pedal to remedy the situation resulting in a very limited yaw rate. Subsequently, the left pedal was further depressed reaching the maximum value of 83% which then led the aircraft to spin rapidly.

2.3.3 Tier 3 – Unsafe Supervision

SI	INADEQUATE SUPERVISION	EVIDENCE
SI 3	**Local Training Issues/Programs.** Local Training Issues/Programs area factor when one-time or recurrent training programs, upgrade programs, transition programs, or any other local training is inadequate or unavailable (etc) and this creates an unsafe situation.	The FRDM's AW189 pilots have never been sent for annual recurrent flight simulator training.

As mentioned, recurrent flight simulator training is a critical aspect of maintaining and enhancing the skills and knowledge of pilots. It is important because flying an aircraft is a complex task that requires a combination of cognitive, motor, and decision-making skills. Recurrent simulator training helps pilots keep their skills sharp, ensuring they can effectively handle the aircraft in various situations.

In this case, it was found that the FRDM had never arrange for their AW189 pilots to attend recurrent flight simulator training. The only time the pilots had their flight simulator training was during their initial type conversion training. Inadequate or unavailable training programs conceivably can compromise the pilot's coordination skills. When faced with a non-routine situation (i.e. emergency) the pilot would be at risk for errors that create an unsafe situation and might lead to a mishap.

2.3.4 Tier 4 – Organisational Influences

OP	ORGANISATIONAL PROCESS	EVIDENCE
OP 7	**Personnel Resources.** Personnel Resources is a factor when the process through which manning,	Annual recurrent flight simulator training is required

	staffing or personnel placement or manning resource allocations are inadequate and creates an unsafe situation.	for all FRDM pilots; however, only AW189 pilots are exempt.

It is clearly stipulated in the Director General Flying Directives (DGFD, Directive 94(b) about the continuation of training, especially simulator training. No doubt that recurrent training can also be performed in a real aircraft itself, however, there are limits to how many times a specific procedure or manoeuvre can be repeated, especially in busy operational environments, and it involves the inherent risks associated with flying.

Recurrent flight simulator training is essential for pilot proficiency, safety, and regulatory compliance. It allows pilots to maintain their skills, practice emergency procedures, and adapt to new challenges in a controlled and cost-effective environment, ultimately contributing to safer and more competent aviation operations.

3.0 CONCLUSION

3.1 Findings

The investigation findings should not be read as apportioning blame or liability to any particular organisation or individual. Some of the findings focus on safety factors (i.e., events and conditions that increase risk). Safety factors include ‘contributing factors’ and ‘other factors that increased risk’ (i.e., factors that did not meet the definition of a contributing factor for this occurrence but were still considered important to include in the report to increase awareness and enhance safety). In addition, ‘other findings’ may be included to provide important information about topics other than safety factors.

3.1.1 Pilots

3.1.1.1 Both pilots were qualified and approved to perform the maintenance flight test in accordance with existing regulations.

3.1.1.2 Both pilots were medically fit and adequately rested to operate the flight.

3.1.1.3 Results for the urine drug panel screen test were negative for substance abuse and the blood alcohol screening test was within the limit.

3.1.1.4 The PIC allowed the OJT student to be carried onboard as an observer upon obtaining approval from the Base Commander.

3.1.1.5 After taxiing to the hover position, the PIC was unaware of the nose wheel's improper centring. The nose wheel's off-centred position prevented the PIC's first left pedal input from producing any discernible left yaw of the aircraft after raising the collective. The PIC then increased the left pedal input in an attempt to straighten the aircraft which then abruptly increased the yaw rate, resulting in the loss of control of the aircraft.

3.1.2 Aircraft

3.1.2.1 The aircraft is registered under civil aviation regulations.

3.1.2.2 The aircraft had a prolonged period of inactivity due to ongoing maintenance of the aircraft by the maintenance operator.

3.1.2.3 The aircraft was equipped and maintained in accordance with existing regulations and approved procedures.

3.1.2.4 The aircraft has a valid C of A and has been maintained in compliance with the regulations.

3.1.2.5 The maintenance records indicated that the aircraft was equipped, and maintained in accordance with existing regulations and approved procedures.

3.1.2.6 The CAS message appeared indicating the "Yaw Trim Failed" during the final turn just before stopping.

3.1.2.7 The aircraft nose wheel position was in an off-centre position during the final stop before it spun.

3.1.2.8 The aircraft spun rapidly to its left while still on the ground and rolled over to its right-hand side.

3.1.2.9 There was an absence of an original copy or a copy of the Insurance Certificate(s) carried on board the aircraft, which covers the aircraft, its crew, passengers, and third-party liability clauses.

3.1.2.10 There were no causal or contributory technical factors identified with the aircraft during the investigation.

3.1.3 Aircraft Operator

3.1.3.1 The aircraft operator (FRDM) did not arrange for its AW189 pilots to attend the stipulated annual flight simulator recurrent training.

3.1.4 Maintenance Operator

3.1.4.1 The maintenance operator (Galaxy Aerospace Malaysia) is an approved MRO organisation by Malaysian civil and military authorities to provide aircraft maintenance, component maintenance, and airworthiness-related services.

3.1.4.2 The maintenance operator overlooked safety hazards at and around the area where maintenance and flight operations were being performed.

3.1.5 Teaching Factory Area (TFA) Operator

3.1.5.1 The TFA operator (UniKL MIAT Subang Campus) did not appoint a qualified Safety Officer for an extended period to oversee the organisation’s safety and security-related matters.

3.1.5.2 There was no evidence of any safety meeting being held between the TFA operator and its tenants to ensure safe operation.

3.1.6 Teaching Factory Area (TFA)

3.1.6.1 The hangar and TFA are not within the perimeter and are not part of the scope of certification of WMSA aerodrome.

3.1.6.2 The TFA is surrounded by safety hazards, such as high-voltage power lines and pylons of substantial height, a shooting range, and tall trees.

3.1.6.3 The TFA has no taxiways or road access connecting it to the WMSA aerodrome's airside.

3.1.6.4 Most of the CCTVs installed within the facility are inoperative.

3.1.6.5 The windsock installed at the facility was only left with the pole, without the windsock.

3.1.6.6 Due to the safety hazard identified above, the TFA was unsuitable for safe routine flight operations.

3.2 Causes/Contributing Factors

3.2.1 **Primary Cause**. From HFACS summary in Figure 14 (see **Appendix E** for details), the primary cause for the mishap is attributed to:

3.2.1.1 One (1) Unsafe Act (Tier 1) as follows:

a. Over-control / Under-control.

3.2.2 **Secondary Causes**. The secondary causes are attributed to:

3.2.2.1 One (1) Preconditions of Unsafe Acts (Tier 2) as follows:

a. Perceptual Factor.

3.2.2.2 One (1) Unsafe Supervision (Tier 3) as follows:

a. Inadequate Supervision.

3.2.2.3 One (1) Organisational Influence (Tier 4) as follows:

a. Resource/Acquisition Management.

TIER 1 – UNSAFE ACTS - ERRORS		**4**	**3**	**2**	**1**
AE 1	Skill-Based Errors	1			5
AE 2	Judgment & Decision-Making Errors				6
AE 3	Misperception Error				1
TIER 1 – UNSAFE ACTS - VIOLATIONS					

AV 1	Violations – Based on Risk Assessment				1
AV 2	Violations – Routine/Widespread				1
AV 3	Violations – Lack of Discipline				1
TIER 1 – UNSAFE ACTS SUB TOTAL		**1**	**0**	**0**	**15**
TIER 2 – PRECONDITIONS FOR UNSAFE ACTS – ENVIRONMENTAL FACTORS					
PE 1	Physical Environment				11
PE 2	Technology Environment				8
TIER 2 – PRECONDITIONS FOR UNSAFE ACTS – CONDITIONS OF INDIVIDUAL					
PC 1	Cognitive Factors			1	7
PC 2	Psycho-behavioral Factors				15
PC 3	Adverse Physiological State				16
PC 4	Physical/Mental Limitations				5
PC 5	Perceptual Factors		1		10
TIER 2 – PRECONDITIONS FOR UNSAFE ACTS – PERSONNEL FACTORS					
PP 1	Coordination/Communication/Planning Factors				12
PP 2	Self-Imposed Stress				6
TIER 2 – PRECONDITIONS FOR UNSAFE ACTS SUB TOTAL		**0**	**1**	**1**	**90**
TIER 3 – UNSAFE SUPERVISION					
SI	Inadequate Supervision		1		5
SP	Planned Inappropriate Operations				7
SF	Failure Correct Known Problem				2
SV	Supervisory Violations				4
TIER 3 – UNSAFE SUPERVISION SUB TOTAL		**0**	**1**	**0**	**18**
TIER 4 – ORGANISATIONAL INFLUENCES					
OR	Resource/Acquisition Management		1		8
OC	Organisational Climate				5

OP	Organisational Processes				6
TIER 4 – ORGANISATIONAL INFLUENCES SUB TOTAL		**0**	**1**	**0**	**19**
TOTAL UNSAFE ACTS		**1**	**3**	**1**	**142**

Figure 14: Summary of HFACS Worksheet

The primary cause of the accident is attributed to the over-compensated left pedal input control by the PIC, which caused the rapid rotation of the nose wheel and an abrupt increase in the yaw rate that led to the subsequent loss of control of the aircraft. This action was taken after the initial left pedal input by the PIC that did not generate any significant left yaw to the aircraft.

The contributing factors were attributed to:

- The aircraft's heading was slightly off to the right when it stopped and required a slight correction to be done by the PIC.
- The PIC's misjudgement of the actual nose wheel position while repositioning the aircraft caused a misperception of the operational condition which led to the skill-based error unsafe acts.
- The AW189 pilots have not attended the stipulated annual flight simulator recurrent training. These inadequate/unavailable training programs conceivably compromise their coordination skills and create an unsafe situation.

3.2.3 **Summary of Findings/Causes**. In summary, the primary cause of the accident is attributed to the over-compensated left pedal input control by the PIC which caused the rapid rotation of the nose wheel and an abrupt increase in the yaw rate, leading to the subsequent loss of control of the aircraft. The accident is categorised as **Loss of Control – Ground (LOC-G)**.

4.0 SAFETY RECOMMENDATIONS

4.1 Immediate Safety Actions of Preliminary Report

4.1.1 The Preliminary Report for this accident issued on 22 August 2023 contained the following recommendation for immediate safety actions to the maintenance operator (Galaxy Aerospace Malaysia [M] Sdn Bhd):

"The maintenance operator shall perform a detailed risk assessment of the operation area and its surroundings to mitigate the existing potential hazards".

Based on the above proposed immediate safety actions, the maintenance operator has conducted several risk assessment discussions involving stakeholders and representatives from the aircraft operator and the facility owner. Subsequently, a Hazard Identification Risk Management (HIRM) was formulated as a risk mitigation tool for their operation and was submitted to the regulator for review.

4.1.2 The Preliminary Report for this accident issued on 22 August 2023 contained the following recommendation for immediate safety actions to the regulator (CAAM):

"CAAM shall suspend any flying activities in and out of the TFA until a detailed risk assessment is performed by the maintenance operator and reviewed in order to prevent future accidents and serious incidents".

As of the date of issue of this report, the regulator has yet to provide any feedback from this recommended immediate safety action.

4.2 Safety Recommendations of this Report

The Safety Recommendations to the respective organisations to address the safety concerns identified in this investigation are as follows:

4.2.1 Aircraft Operator (FRDM)

4.2.1.1 To ensure all its civil registered aircraft have an original or a copy of the Insurance Certificate(s) carried on board the aircraft, which covers the aircraft, its crew, passengers, and third-party liability provisions.

4.2.1.2 To arrange for its AW189 pilots to attend flight simulator recurrent training annually as stipulated in the DGFD.

4.2.2 TFA Operator (UniKL MIAT Subang Campus)

4.2.2.1 To resolve all the safety hazards at the TFA that have been identified in this report before resuming normal flight operations at the facility.

4.2.3 CAAM

4.2.3.1 To ensure all government-owned (State) aircraft that are civil registered have valid insurance certificate(s) as required under the provision of the CAD 06 Part 03.

4.2.3.2 To review and reconsider the consent for routine aircraft operation at uncertified aerodromes or other flight operation facilities where there is an absence or inadequate risk control and mitigation measures to ensure safe operation. particularly in hazardous environments such as the UniKL MIAT's TFA facility.

5.0 COMMENTS TO DRAFT FINAL REPORT AS REQUIRED BY ICAO ANNEX 13 PARAGRAPH 6.3

In accordance with ICAO Annex 13 paragraph 6.3, the Draft Final Report was sent to the State of Registry (CAAM), the State of Manufacturer (ANSV), the Teaching Factory Area Operator (UniKL-MIAT Subang Campus), the Aircraft Operator (Fire and Rescue Department of Malaysia), and the Aircraft Maintenance Operator (Galaxy Aerospace Malaysia (M) Sdn Bhd) inviting their significant and substantiated comments on the report. The following are the status of the comments received: -

Organisations	Status of Significant and Substantiated Comments
Civil Aviation Authority of Malaysia (CAAM)	Report accepted and no comments

Civil Aviation Safety Investigation Authority of the Italian State (ANSV)	Report accepted and amended accordingly
Fire and Rescue Department of Malaysia (FRDM)	Report accepted, amended, and appended accordingly
UniKL-MIAT Subang Campus	Report accepted and no comments
Galaxy Aerospace Malaysia (M) Sdn Bhd	Report accepted, amended, and appended accordingly

Figure 15: Status of significant and substantiated comments

CONCLUDING STATEMENT

This investigation has revealed instances of non-compliance and errors; however, it is crucial to emphasise that these findings are not intended for the purposes of apportioning blame or liability. Rather, they are solely for the purpose of preventing accidents in the future and improving aviation safety on the whole. Addressing the identified findings and implementing the recommended safety measures will enhance aviation safety and mitigate risks associated with operational lapses and regulatory gaps. It is imperative that all stakeholders prioritise safety and commit to implementing the necessary measures to prevent recurrence.

INVESTIGATOR IN CHARGE (IIC)
Air Accident Investigation Bureau (AAIB)
Ministry of Transport Malaysia