
# GOVERNMENT OF INDIA

## CIVIL AVIATION DEPARTMENT

# INVESTIGATION REPORT

# INCIDENT TO A109SP HELICOPTER VT-YMA OF M/S LULU INTERNATIONAL Pvt. Ltd. AT COCHIN ON 11th APRIL-2021

**OFFICE OF THE DIRECTOR OF AIR SAFETY**

**(SOUTHERN REGION), CHENNAI**

## FORWARD

This document has been prepared based upon the evidences collected during the investigation, opinions obtained from the experts, and laboratory examination. The investigation has been carried out in accordance with Annex 13 to the Convention on International Civil Aviation and under Rule 13(1) of The Aircraft (Investigation and accidents and incidents) Rules 2017.

The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this incident which may help to prevent such future incidents.

# INDEX

# Final Investigation Report on Incident to A109SP helicopter VT-YMA of M/s Lulu International at Cochin on 11th April-2021

a. Aircraft Manufacturer : Leonardo S.p.A (Agusta Westland)
   i. Model : AW109SP
   ii. State of Registry : India
   iii. Registration : VT-YMA
b. Name of the Owner : M/s Lulu International Shopping Mall Pvt.Ltd.
c. Name of the Operator : M/s Lulu International Shopping Mall Pvt.Ltd.
d. Pilot – in – Command
   i. License : Valid ATPL(H) on AW109SP Helicopter
e. Co-pilot
   i. License : Valid ATPL(H) on AW109SP Helicopter

f. Passengers: -
   a. No. of Persons on board : 04 Passengers + 02 crew members
   b. Extent of injuries : nil
g. Place of incident : Open field in Panangad, Cochin
h. Date & Time of Incident : 11-04-2021; 08:47 Hrs IST.
i. Last point of departure : Y Mansion, Kadavanthra, Cochin (Private Helipad)
j. Point of intended landing : Lakeshore Hospital Helipad, Cochin
k. Nature of Operation : Private
l. Phase of Operation : Approach
m. Type of incident : Loss of Control – In-flight
n. Aircraft Damage : Minor

(All timings in the report are in IST unless or otherwise specified)

## SYNOPSIS: -

On 11th April 2021 at 08:43 Hrs. IST, M/s Lulu International Shopping Mall Pvt. Ltd Helicopter AW109SP registration VT-YMA was operating private flight from a Private helipad (residence 'Y mansion', Kadavanthra, Cochin) to Lakeshore Hospital Helipad, Cochin.

The helicopter was under the command of a duly qualified PIC holding an ATPL (H) license on type along with a Co-Pilot duly qualified on type. There were four passengers on board the helicopter. Take-off and climb was uneventful, flight altitude did not exceed 700 ft Above Ground Level (AGL) and Indicated Air Speed (IAS) was maintained below 100kts. During approach, the helicopter became uncontrollable, lost altitude rapidly and settled on a marshy land. Upon landing, the helicopter partially sank into the mud (dirt water) up to 2 feet. There was no injury to any of the occupants on board the helicopter, and there was no smoke/ fire. The incident took place at 08:47 Hrs IST. It was raining at the time of incident.

(Fig. 1: Helicopter at Incident site)

The Director General of Civil Aviation instituted an investigation into the incident and appointed an Investigation-in-Charge to investigate into the cause of the incident vide Order No: DGCA-15019(01)/1/2021 dated 15th April 2021 under Rule 13(1) of The Aircraft (Investigation and accidents and incidents) Rules 2017.

The investigation concluded with the following cause:

The Pilot maneuvered the helicopter with unusual high pitch attitude, and with low torque setting, resulting into high rate of descent at low altitude. Subsequently, the helicopter entered into Vortex Ring State and the pilot lost control of the helicopter and the helicopter impacted the ground.

Non adherence to Standard operating procedures by the crew and lack of situational awareness is the contributory factor to the incident.

# 1. FACTUAL INFORMATION

## 1.1. History of the flight

### 1.1.1. Background

The helicopter belonging to M/s Lulu International Shopping Mall Pvt. Ltd was operating a passenger flight from a private helipad "Y Mansion" to a Helipad located at lakeshore helipad, Cochin with four passengers on board.

"Y Mansion helipad' is 14 NM from Cochin Airport. The Aerial distance between Y mansion and Lakeshore Hospital is 02 NM with a planned flying time of less than 5 Minutes.

Daily inspection of the helicopter was carried out by a qualified Engineer prior to the departure. There was 310 Kg of fuel on-board and nil defect. PIC accepted the helicopter, carried out preflight checks and coordinated with ATC unit at INS Garuda for departure.

The helicopter was under the command of PIC duly qualified on type holding an ATPL(H) license. The PIC was also a DGCA approved Type rated instructor on this helicopter. The Co-Pilot was an ATPL(H) license holder and a DGCA approved Examiner on type.

The PIC was the Pilot Flying (PF) and Co-Pilot was the Pilot Monitoring (PM) for this flight.


(Fig. 2: Graphical representation of Flight path)

Both the crew carried out Pre-flight medical check at 'Y Mansion' as per CAR Sec 5 Series F Part III and found negative.

Before take-off, crew activated Engine torque limiter function. This function limits the torque produced by the engine to 220 % instead of its maximum capability of 324% with All Engine Operating (AEO). The helicopter took off from 'Y mansion' helipad at 08:44Hrs IST with All Up Weight (AUW) of 3063.75 Kg and accelerated to forward flight with a positive rate of climb. Throughout the flight, the maximum altitude reached was around 700 ft AGL and IAS remained below 100 Kts. The helicopter was flown manually without activation of Autopilot and Flight Director. As the planned flight time was less than 5 mins, the helicopter was flown with landing gear in extended condition.

At approximately 2 mins from take-off, the helicopter initiated a Left bank turn in order to approach the Hospital from the south. It was raining over the approach path. During approach, the helicopter became uncontrollable, lost altitude and settled on a marshy land. Upon landing, the helicopter partially sunk into the soft mud with dirt water entering the cockpit by up to 2 feet. Engines were shut down and all the occupants vacated the helicopter by standard exit and were transported to nearby hospital. There was no injury to any of the occupants on board, and there was no post incident smoke or fire.

The final resting place was an enclosed marshy field near Panangad Police station, which is approx. 0.7 NM (less than 2 Km) away from Laksehore Hospital helipad. The coordinates of the landing site is 9.907072°N and 76.316496°E.

### 1.2. Injuries to persons

| Injuries | Crew | Passengers | Others |
|---|---|---|---|
| Fatal | Nil | Nil | Nil |
| Serious | Nil | Nil | Nil |
| ~~Minor~~/ None | 02 | 04 | |

### 1.3. Damage to aircraft

The helicopter settled on a marshy land filled with dirt water. Minor structural damages were observed on the helicopter, mainly on the undercarriage.

The helicopter sustained following Minor damages. - Photos are available in Annex.

1. The cockpit was flooded with dirt water up 2 ft.
2. Main Rotor Blade s/n-AW1812 found cracked near the Trim Tab.
3. Nose landing gear door damaged.
4. Chin bubbles (Cockpit lower glass) LH & RH found damaged.
5. Access panels damaged
6. Drain and vent lines along the belly found deformed.

7. LH& RH Sponson Landing/taxi Light Glass found Broken.
8. Lower Fin adjacent to tailskid found Deformed& Cracked

All the damages observed were found to be post impact consequential damages and no evidence suggest that the damage took place on air or prior to the incident flight.

### 1.4. Other damage

There was no other damage.

### 1.5. Personnel information

#### 1.5.1. Pilot-in-command

The PIC had undergone Initial helicopter Training at Helicopter Training School, Indian Navy in July 1990 and has also been an Experimental Test Pilot. He obtained DGCA CHPL license on 19th May 2010, further upgraded to ATPL(H) in June 2014.

He joined the Organization, M/s Lulu International on 01 Feb 2018 and was holding the post of Director of Flight Operation/ Chief Pilot. PIC was also a DGCA approved Type Rated Instructor on AW-109 type of helicopter. Prior to this incident the PIC was not involved in any incident/ accident.

| | |
|---|---|
| AGE/ Gender | : 54; Male |
| License | : DGCA India - ATPL (H) |
| Date of issue | : 23-06-2014 |
| Valid up to | : 22-06-2021 |
| Category | : Commercial Air Transport Helicopter License |
| Date of medical Exam | : 09-12-2020 |
| Medical Exam valid up to | : 21-06-2021 |
| Date of issue of FRTO license | : 16-05-2010 |
| FRTO license valid up to | : 14-06-2025 |
| IR rating and instructor rating | : AW109, valid. |
| Total flying experience on Civil Helicopters | : 1735:15 Hrs. |
| Total flying experience on Type (AW109) | : 1230:25 Hrs. |
| Total flying experience during last 1 year | : 77:25 Hrs. |
| Total flying experience during last 6 month | : 57:40 Hrs. |
| Total flying experience during last 30 days | : 02:55 Hrs. |
| Total flying experience during last 07 days | : 02:55 Hrs. |
| Total flying experience during last 24 hours | : 02:15 Hrs. |
| Duty time last 24 hours | : 11 Hrs. |

### 1.5.2. Co-Pilot

The Co-Pilot had undergone Initial helicopter Training at Helicopter Training School, Indian Air Force in Jun 1985. He obtained DGCA CHPL license on 20th Dec 2007, further upgraded to ATPL(H) in July 2014.

He joined the Organization, M/s Lulu International on 1st Oct 2018 and holding the post of Director/ Chief of Flight Safety. He is also a DGCA approved Examiner on AW-109 type of helicopter. Prior to this incident the Co-Pilot was not involved in any incident/ accident.

| | |
|---|---|
| AGE & Gender | : 57; Male |
| License | : DGCA India - ATPL (H) |
| Date of issue | : 03-07-2014 |
| Valid up to | : 02-07-2021 |
| Category | : Commercial Air Transport Helicopter License |
| Date of medical Exam | : 09-12-2020 |
| Medical Exam valid up to | : 21-06-2021 |
| Date of issue of FRTO license | : 19-05-2010 |
| FRTO license valid up to | : 14-06-2021 |
| IR rating and instructor rating | : AW109, valid. |
| Total flying experience on Civil Helicopters | : 1914:00 Hrs. |
| Total flying experience on Type (AW109) | : 1745:00 Hrs. |
| Total flying experience during last 1 year | : 80:10 Hrs. |
| Total flying experience during last 6 month | : 59:20 Hrs. |
| Total flying experience during last 30 days | : 02:55 Hrs. |
| Total flying experience during last 07 days | : 02:55 Hrs. |
| Total flying experience during last 24 hours | : 02:15 Hrs. |
| Duty time last 24 hours | : 11 Hrs. |

### 1.5.3. Flight Crew training, and duty time

Training

Most of the helicopter trainings of the PIC were conducted by the Co-Pilot and vice versa, as they both are DGCA Approved Trainers.

As per CAR Section 8 Series O Part V, "All pilots are required to undergo recurrent training at least once in two years, on a Full Flight Simulator Level B/C/D or FTD 6/7 (FAA Designation) wherein all critical emergencies are to be covered in a period of two years".

For both the pilots, Simulator training was due in the year 2020. Due to COVID-19 Pandemic, DGCA issued Operations Circular 02 of 2020 regarding conduct of various training, wherein, in place of Simulator training for practicing critical emergencies, DGCA has approved carrying out the same on the Helicopter with a TRI/TRE for 04 Hours.

Therefore, both the pilots had undergone checks on the helicopter for 04 hours. The crew had undergone all mandatory trainings as required by CAR.

Duty time:

The duty period for the past 24 Hrs (ie 10-04-2021) was 11 hours with split duty from 1000 Hrs till 1505 Hrs IST. The crew had weekly rest as per regulations. The incident flight was the first flight of the day.

Crew pairing & Familiarity of Route and terrain:

The organization has only two pilots on this helicopter. The two pilots had flown together as a crew on several occasions in the preceding six months; the most recent was on 10-04-2021 (a day prior to the incident) local flying. The incident sector ('Y Mansion' to Lakeshore helipad) was last operated by the same set of crews on 24-02-2021.

#### 1.5.3.1. Flight Crew Statement & Interview

As per both the flight crew, there was rain while approaching the destination. During approach, at around 300 ft AGL, they experienced sudden sink in helicopter altitude. As there was no height to get away, they made a forced landing on a vacant land. Post incident, crew informed ATC that the helicopter made forced landing due to 'loss of engine power'

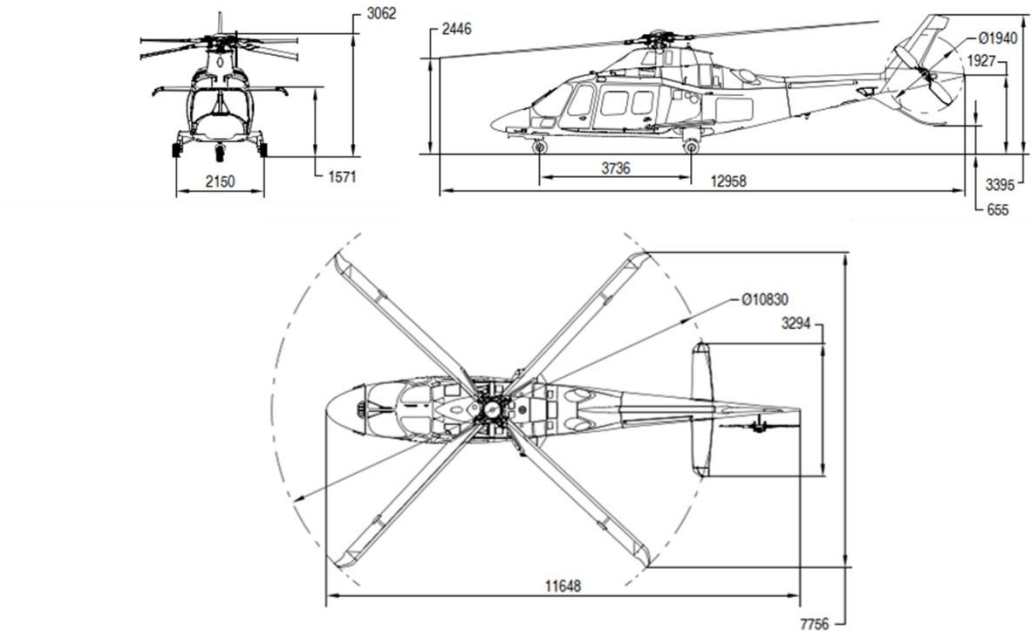
### 1.5.4. Other crew

Nil

## 1.6. Aircraft information:

### 1.6.1. Aircraft Description

A109SP was designed and manufactured by M/s Leonardo S.p.A (Agusta Westland), Italy. It is powered by two turbo shaft engines with four bladed Main Rotor and Two bladed Tail Rotor. It has a retractable tricycle-type landing gear. The helicopter is certified in transport category, under single pilot VFR and IFR, day and night land operations under non icing conditions. The helicopter is certified for single and/or dual pilot operations. The helicopter has got most of the advanced features and systems of Communication, Navigation, Indication and recording systems. The aircraft has a Max. Take-Off weight of 3175 Kg, with a 15600 Ft.



(Fig. 3: Helicopter Design Specification)

| | |
|---|---|
| Helicopter S.No. | : 22394 |
| Year of Manufacturing | : 2018 |
| Certificate of Registration | : Valid, issued on 27-12-2018 |
| Certificate of Airworthiness | : Issued on 21-01-2019; Validity - Lifetime |
| Airworthiness Review Certificate | : Issued on 18-01-2021; Validity - 20-01-2022 |
| Aircraft Hours since New | : 225:47Hrs |
| Total time since C of A | : 191:56 Hrs |
| Last Inspection | : 200 Hrs & 12 Months Inspection done at 191:56 Hrs on 20-10-2020 |
| Repetitive Snags (last 15 Days) | : Nil |
| Major Snags reported | : Nil |

### 1.6.2. Engines

The engine installation consists of the two Pratt & Whitney Canada 207C engines. The PW207C is a lightweight, free-turbine, turboshaft engine incorporating a single stage centrifugal compressor driven by a single stage turbine. A single-channel Full Authority Digital Electronic Control (FADEC) system with a mechanical back up FMM ensures accurate control of the engine output speed and fast response to changes in power demand.

Specific details of Engines installed on this helicopter:

| Engine S. No. | Engine Hours since new |
|---|---|
| LH - BH-0906 | 224:47 Hrs |
| RH - BH-0904 | 224:47 Hrs |

### 1.6.3. Engine Power Assurance check

As a part of 25 Hrs. inspection, Engine power assurance checks were carried out at Ground Hover and the engine parameters were recorded by the crew as well in the DAU on 18-01-2021. The recorded N1 & TOT values were less than the allowable N1 & TOT values. Both the engines showed performance well within the accepted limits.

### 1.6.4. Engine Torque Limiter

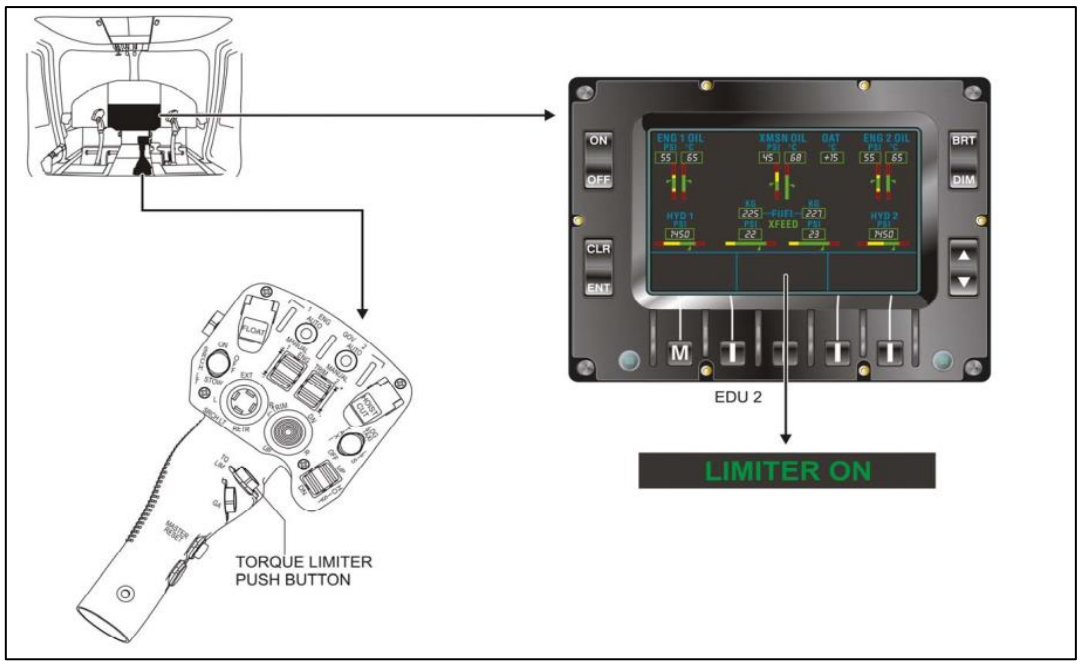
As per design, when the helicopter is powered ON, the torque limiter function will be OFF. The Engine Control Unit (ECU) will allow the Engine torque to reach up to 324% (162% per side) on All Engine Operation (AEO).

The Engine Torque Limiter function is enabled by pressing the relevant button, located on the collective switch box.

When the Engine Torque Limiter function is enabled, the ECU prevents the total engine torque from exceeding 220% (110% per side) on AEO.

When the ECU detects this selection, sends a signal to the Data Acquisition Unit (DAU) that generate a "LIMITER ON" advisory message on the Electronic Display Unit (EDU 2). These limits can be reset upon pilot's command, to disable the function a second push on the button is necessary.

As per engine manufacturer, when this limit is reached (total torque reaching 220%), the fuel flow to the engine is decreased, which will in turn reduce rotor speed.

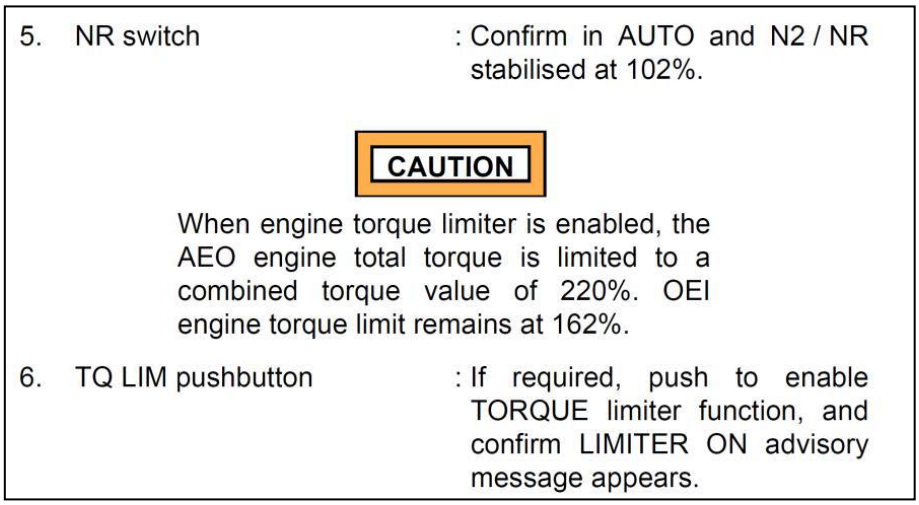



(Fig. 4: Torque Limiter push button on Collective; EDU showing 'Limiter ON')

The Rotorcraft Flight Manual (RFM) for AW109SP provides a 'caution message' in the 'Before Take-Off' checks regarding usage of Engine torque limiter function and its implications. As per the RFM, this function is required to be kept active during Automatic Flight Control System (AFCS) Upper Modes and Flight Director Modes. Apart from this, there is no other guidelines or requirements provided by the Helicopter or engine manufacturer regarding usage of Engine torque limiter.

The incident flight was flown manually, therefore it as not mandated to activate Engine torque limiter function.

The activation or deactivation of Torque limiter function in manual mode is left to Pilot's judgment and it can be activated or deactivated during any phase of flight.
However, deactivating Torque limiter may increase maintenance burden if the torque reaches 324%. But, proper mission planning and flight maneuvering to be carried out by the crew by taking this additional limit into account.




(Fig 5: Extract of AW109SP RFM -'Normal Procedures')

A specific caution for activation of Torque Limiter function is given on the RFM in the 'before take-off checks' section of the Normal Procedures.

### 1.6.5. Maintenance

The helicopter was maintained by M/s OSS Air Management, which is a CAR 145 organization. As on date of incident, the helicopter had completed 225:42 Airframe hours since New. The most recent inspection was 7 days inspection carried out on 08-04-2021 at 224:08 Hrs.

Last major inspection carried out on this helicopter was "200 Hrs/ 12 month" Inspection at 191:15 Hrs/ 20-10-2020.

On the day of incident, before the first flight, the AME reported for work and carried out 'Before first flight inspection' and 'Pre-flight inspection' as per approved schedule. The helicopter was released with 310 Kg of fuel on board with nil defects/ MEL.

There were no significant defects reported for the last 25 airframe hours. The recent defect was related to engine reported on 24-11-2020, which was "#1 ENG oil filter impending bypass indicator found pop-out", for which #1 ENG oil filter was replaced. There was no repetitive and major snags reported for this helicopter.

All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modification on this helicopter and its engine have been complied with as & when due.

### 1.6.6. Indication and warning devices

This section explains the display units and systems available in this helicopter aiding the pilots for easy navigation of the helicopter, also by providing caution and warning messages.

The Integrated Display System (IDS) monitors the engines and airborne systems and provides the pilots with all the corresponding parameters and values and warning, caution, advisory and status messages.

The system mainly consists of a Data Acquisition Unit (DAU) and two Electronic Display Units (EDU).

The Electronic Display unit 1 & 2 displays all Engines and systems information and graphical form, also shows Crew Alerting System (CAS) area, warning, caution, advisory and status messages. The Electronic Flight Instruments System (EFIS) consists of 4 Displays; 2 displays are mounted on the Pilot side and 2 on the Co-Pilot side which provides complete navigation parameters to the pilots

The helicopter is equipped with a Radar Altimeter Rockwell/Collins ALT-4000 that provides the altitude AGL (above ground level). The system provides instantaneous indication of the height of the helicopter above the terrain between 0 and 2500 ft.

The Radar Altimeter System is also interfaced to the Audio Warning Generator (AWG) in order to activate the voice annunciations that follow:

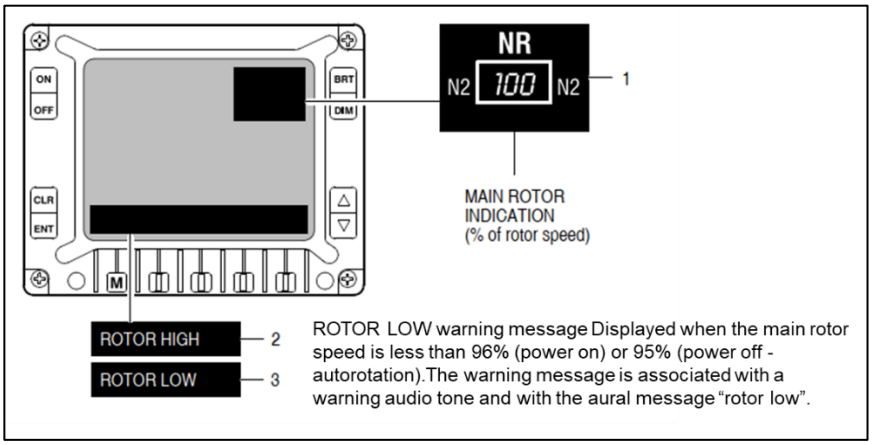
Two hundred Feet
LANDING GEAR (repeated twice)
DECISION HEIGHT

There is no system which provides warning if the helicopter descends too fast/ RoD increases above certain threshold limits.

All the four displays were working normally during the entire duration of the flight.

#### 1.6.6.1. Main Rotor Indicating System

The main rotor indicating system indicates the rotational speed of the rotor in percent of the maximum rating. The system consists of the rotor RPM sensor (magnetic pick-up) installed on the main transmission and electrically connected to the pilot's EDU.




(Fig. 6: EDU highlighting indications of ROTOR LOW & HIGH caution)

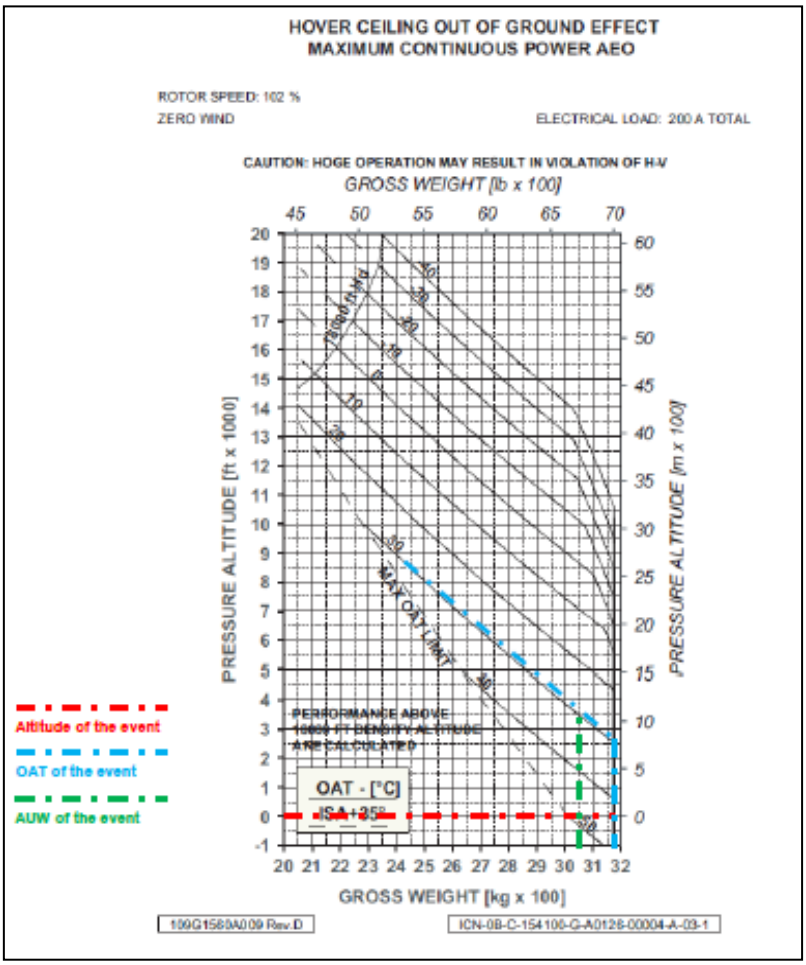
'ROTOR LOW' warning message is displayed when the main rotor speed is less than 96% (power on) or 95% (power off -autorotation). The warning message is associated with a warning audio tone and with the aural message "rotor low". The warning audio tone and the aural message reset when the NR is less than 80%.

### 1.6.7. Loading and Performance of helicopter

The Weight schedule and Load sheet of the helicopter was approved by DGCA. The crew calculated Load and Trim for carriage of four passengers with a standard weight of 75 Kg/pax and two crew with a standard weight of 85 Kg/ crew.

The Max. Take-off/ All Up weight of the helicopter is 3175 Kg. The All Up Weight during Take-Off and landing was 3063.75 Kg & 3023.75 Kg respectively, and the calculated C.G. was at 3.305m & 3.297m aft. of datum. The CG was within the allowable CG envelope.

According to the published RFM Performance charts, the helicopter can achieve HOGE at MTOW in the conditions of the incident day (30°C OAT and 0ftAMSL), even when limiting power to AEO MCP (i.e. 100% on each side).




(Fig. 7: Performance chart: Extract of AW109SP RFM Section 4)

### 1.6.8. Digital Audio Control System (DACS)

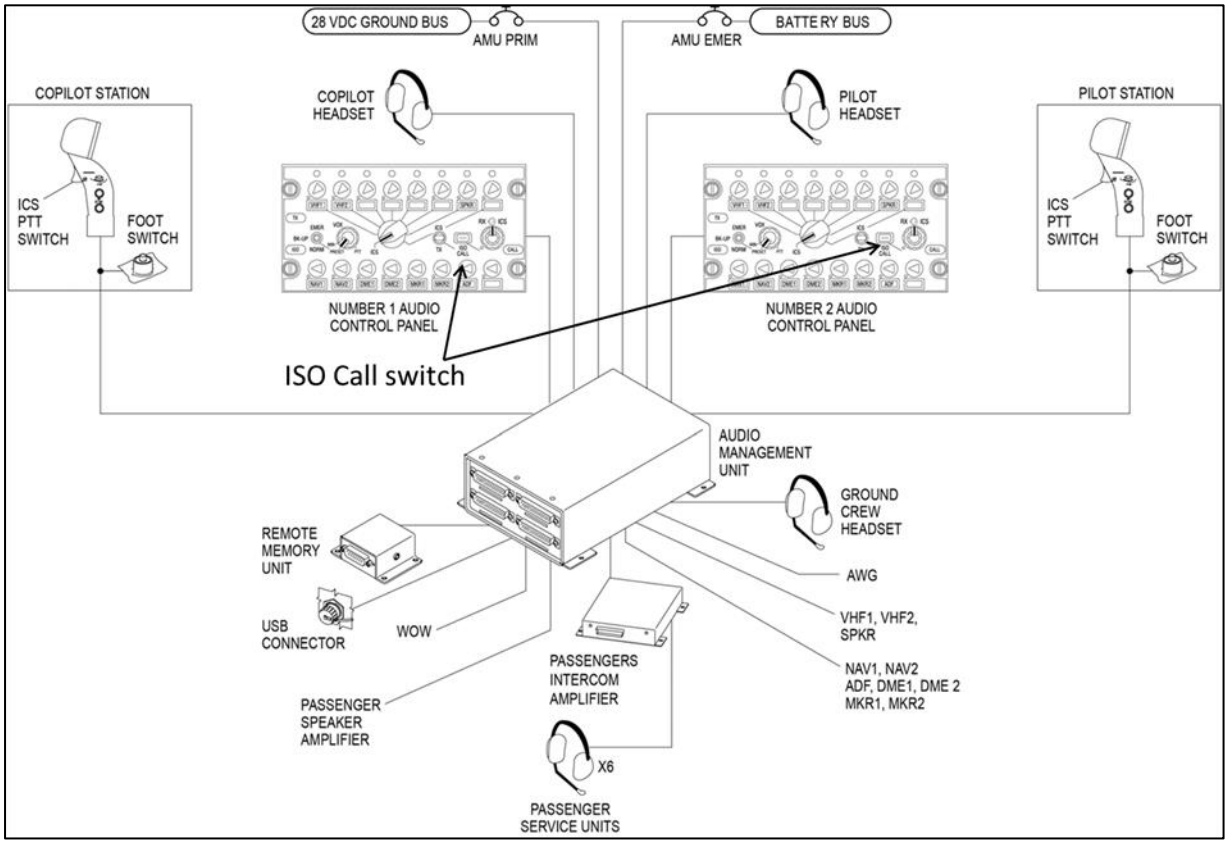
The DIGITAL Audio Control System (DACS) is a communications management system that distributes and controls all audio in an aircraft. It manages the audio from all transceivers, receivers and audio warning sources. It allows the transmission of microphone audio to a selected transmitter and distributes all intercom audio.

There are two audio control panels, one each for Pilot and Co-Pilot access. The Audio Management Unit (AMU) sums and distributes all audio to each user attached to it and to the Passenger Intercom Amplifier. Through this system, the passengers and pilots can interact during the flight. This also enables passengers to listen to all conversations between both the pilots as well as ATC.

The pilots can use the ISO CALL push-button Switch on the Audio control panel to isolate themselves from the passengers.

A clear and uninterrupted conversation between the pilots is necessary for flying the aircraft with proper CRM which also includes carrying out checklists and effective response of crews in handling critical emergencies.

In this incident, as per CVR recordings and clarification from both the pilots, it was observed that audio inputs of all the channels (Pilot, ATC & Passenger conversations) were fed to pilot's headphones. The crew did not isolate themselves from the passengers during the flight. This has been the practice in the organization.




(Fig.8: Digital Audio Control System)

## 1.7. Meteorological Information

The departure and arrival ports being temporary helipads, there is no weather reporting center. Whereas, the weather reports of Cochin Airport (VOCI) which is 14 NM away was taken for flight planning as there was no other nearby weather stations. The incident took place during daylight conditions.

As per weather report

MET Report of Cochin station at time 03:00 Hrs UTC/ 08:30 Hrs IST.

| | | | |
|---|---|---|---|
| Wind | : 110 | Wind Speed | : 03 KT |
| Visibility | : 4000m | WX | : BR (mist) |
| Cloud 1 | : Scattered 1500 ft | Cloud 2 | : Broken 8000 ft |
| Temp | : 28o C | Dew Point | : 24 |
| QNH | : 1012 hPa | QFE | : 1011 hPa |
| Trend | : NOSIG | | |

This indicates, scattered cloud at 1500 ft, with visibility of 4000m due to mist and light wind. As per the operating crew, during approach and at the time of incident, there was rain during approach.

## 1.8. Aids to Navigation

### 1.8.1. Ground based navigation aids

The departure and destination are temporary helipads, and no aids to navigation are available. Whereas, in case of emergency, navigational aids are available at Cochin (VOCI) Airport.

### 1.8.2. Helicopter Navigation aids

The navigation system in the helicopter includes:

– The flight environment data

– The attitude and direction system

– The landing aid system

– The Independent position determining system

– The dependent position determining system.

All conventional navigational aids such as VOR1/ADF, VOR2/ILS, DME system are available. The helicopter is also equipped with GPS based Digital Mapping System (DMS) having the databases of area maps, Jeppesen charts and various other features to enhance situational awareness.

There was no fault or ineffectiveness reported by the crew.

## 1.9. Communications

The incident sector was under the lateral jurisdiction of Cochin Garuda ATC belonging to Indian Navy. As per the crew, the clearance for flight including Take-off clearance was

obtained telephonically from Garuda ATC. Upon take-off, crew reported their position and ETA. After the incident, the crew informed ATC units of Garuda as well as Cochin Airport.

There was two ways communication maintained.

## 1.10. Aerodrome Information

The departure and destination helipads are temporary helipads. These helipads are owned by the Operator's parent company and being used by the operator.

| Helipad | Coordinates |
|---|---|
| 'Y Mansion' – private residence | 09°56'56''N, 76°18'27''E |
| Lakeshore Hospital | 09°54'59''N, 76°19'08''E |

## 1.11. Flight Recorders

### 1.11.1. Introduction

This helicopter is equipped with a combined unit of CVR & DFDR ie. (CVDR)

| Unit | Part Number | Serial Number |
|---|---|---|
| CVDR | D51615-202-005-090 | A18560-001 |

The CVDR System on AW109SP is composed of

1. A Data Acquisition Flight Recorder (DAFR)
2. A Control Unit
3. A Cockpit Area Microphone (CAM)
4. An Impact Switch

The unit provides sufficient memory capacity to store at least the latest 25 hours of the acquired Aircraft parameters (in excess of 830) in a crash protected memory, together with latest 2 hours of audio from each of the four inputs (Pilot, Co-Pilot, Cabin operator and Cockpit Area Microphone). A complete data and audio record of the accident flight was available. The flight data and audio records ended when the helicopter landed on the surface and engines were switched OFF. Data was also recovered and analyzed from Data Acquisition Unit (DAU) and Engine data collection (ECU).

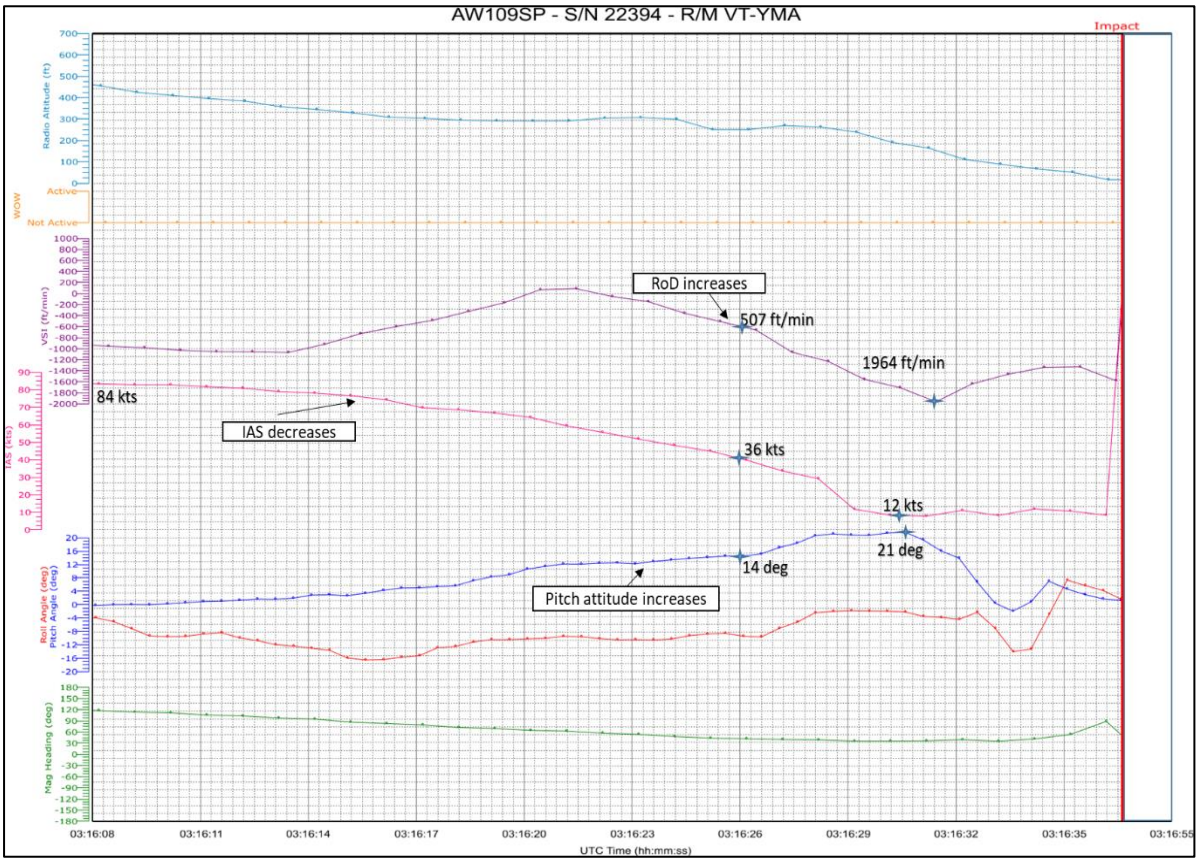
### 1.11.2. DFDR

The DFDR data was analyzed along with the inputs from M/s Leonardo Helicopter and M/s Pratt & Whitney.

Salient parameters from CVDR includes: Indicated Air Speed (IAS), radio altitude, vertical speed, collective position, engine torques, rotor speed.

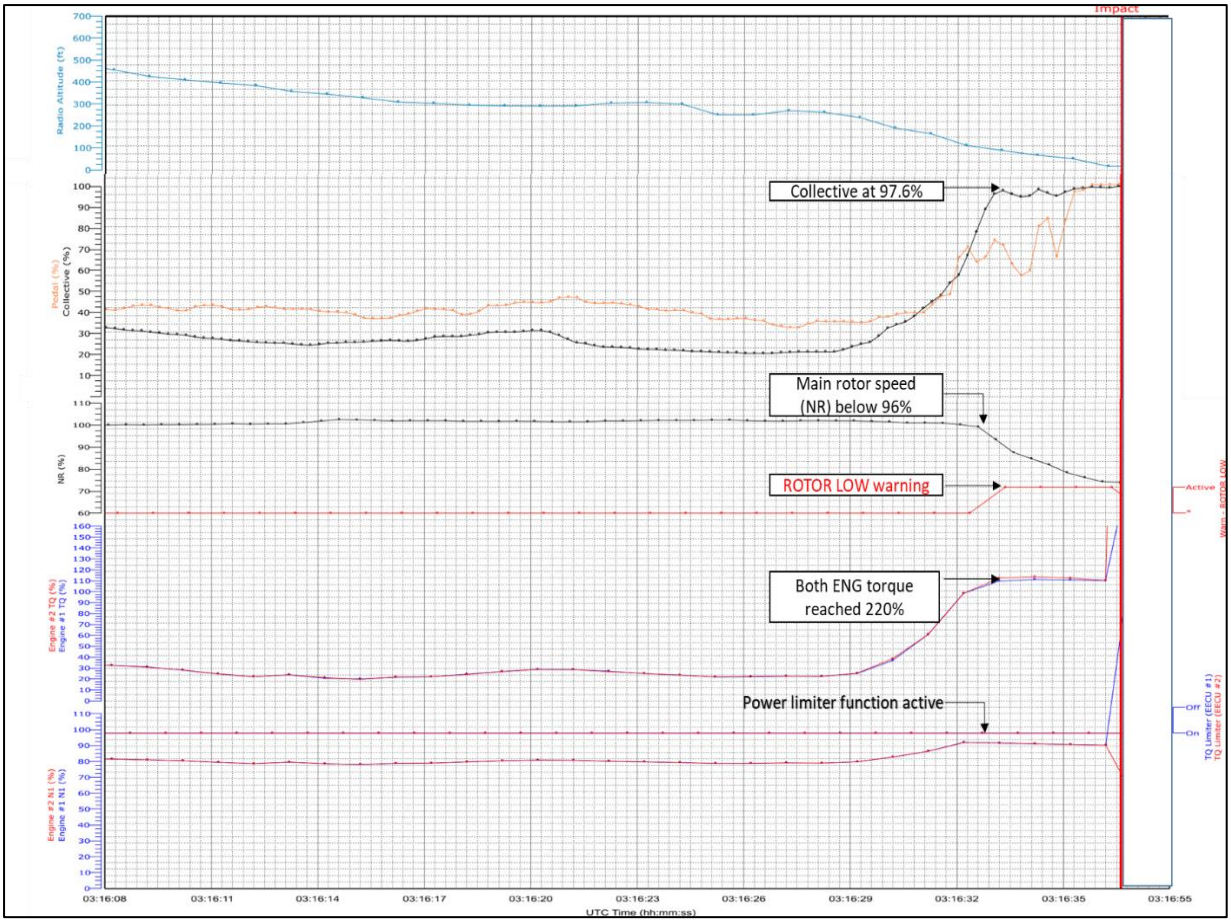
Based on the DFDR data, the flight of VT-YMA is summarized as follows:

1. The helicopter was flown manually by the crew, and controls inputs on 4 axis were coming from the Pilot Flying (ie, PIC in this case) with the authority of Autopilot and Flight Director not active.
2. The Engine Torque limiter function was enabled by the crew before Take-off and remained ON throughout the flight.
3. The helicopter took off at 03:13:38 UTC and reached a max altitude of 650 ft AGL.
4. During the entire flight, landing gear was in extended position.
5. At 03:15:46 UTC, around 500 ft AGL, the helicopter made final left turn to the destination - Lakeshore Hospital.
6. During this turn, the PF slowly and progressively increased the Pitch attitude of the helicopter from an initial (almost) level condition up to 15° at 03:16:27 UTC. As the Engine TQ demand was neither increased nor maintained during this time, but instead was slightly decreased down to approximately 30% (TQ reduced from ~50% to 21%) the result was a progressive reduction of IAS from 80kts (at the beginning of the turn) down to ~40kts, and a consequent increase of the Rate of Descend.



(Fig. 9: Flight Control data for final part of flight)

7. At 03:16:30 UTC, around ~260 ft AGL, pitch attitude was being further increased above 15° and reached approximately 21°. As no significant Collective compensation was applied up to that moment, VSI peaked at ~2000 ft/min RoD, while IAS reached 0kts.




(Fig. 10: Power plant data for final part of flight)

8. From this point of time onwards the PF applied almost full Collective (97.6% was reached at 03:16:34 UTC), possibly to try and counteract the perceived sink. The result was an immediate TQ increased by both Engines, which reached the 220% cap less than 1s later, as the Torque limiter was still active.
9. The full Collective application, coupled with the limited power output caused a progressive Main Rotor Speed (NR) droop. The Warning ROTOR LOW activated below 96%, as designed. No other Warning or Caution message was present.
10. As the Pitch attitude remained above 20° and NR speed continued to decrease, the aircraft continued its descent towards the terrain. A final attempt to level off was made below 100ft AGL, but the aircraft impacted the terrain shortly after at 03:16:41 UTC, with a residual ROD of ~1500fpm and NR at approximately 74%.

### 1.11.3. CVR

The CVR recordings of the complete flight was available for analysis.

Following are the salient observations from the CVR:

1. The entire conversations of crew and ATC were overlapped with inter-cabin conversations (passenger conversation), indicating that the crew did not isolate themselves from the cabin communications.
2. The crew did not make use of Normal Checklist, but carried out few checks from their memory.
3. The crew with the use of weather radar, had noticed rain patches in the flight path before take-off. They discussed about its movement and also turned the Wiper ON.
4. By the time they made left turn to the Lakeshore Hospital, crew discussed that there was slight rain on the downwind.

| | | |
|---|---|---|
| 08:45:07 IST | P2 to P1 | Downwind, rain patch is there *(in Malayalam)* |

5. Co-Pilot informed PIC to slow down so that the rain patch moves. After few seconds landing checks were done out of memory, in which 'speed less than 140 knots' was called out.

| | | |
|---|---|---|
| 08:45:17 IST | P2 to P1 | Slow Slow, let the rain move *(In Malayalam)* |
| 08:45:50 IST | P2 to P1 | Landing check, speed less than 140 knots, parking brake, nose wheel lock |

6. PIC enquired about height, Co-Pilot replied '290 maintaining, 250'

| | | |
|---|---|---|
| 08:46:17 IST | P1 to P2 | What is the height |
| 08:46:19 IST | P2 to P1 | 290 maintaining… 250 |

7. After 9 seconds, system aural notification "200 ft"
8. After this there was no communication of cockpit crew. System sound, background, rotor sound suggested that the helicopter had impacted the ground.
9. The above-mentioned Point No. 1 & 2 were observed in recent flights operated by the same crew set.
10. There was no non-operational conversation during the entire flight.

### 1.12. Wreckage and Impact Information

The helicopter settled on a marshy land and partially sank into the mud. Landing gear was in extended position. On impact on land, the helicopter sank up to 2 ft approx. On examination, it was observed that the helicopter suffered only consequential damage post

impact to ground. There was no damage to the helicopter except these mentioned in section 1.3. The helicopter was recovered on the same day by following AMM procedures.


(Fig. 11: Helicopter final impact)

The coordinates of the landing site is 9.907072°N and 76.316496°E.

### 1.13. Medical and Pathological Information

Persons on board includes two crew and four passengers survived the incident without any injuries. The Crew and the passengers were subjected to clinical examination after the incident and no observation relevant to the incident was found.

The crew had undergone Pre-flight medical check before the start of the flight for detection of influence of alcohol as per DGCA guidelines, and found negative.

### 1.14. Fire

There was no evidence of smoke or fire before and after the incident.

### 1.15. Survival Aspect

The helicopter settled on an open marshy land in the urban area. Upon settling on the land, the helicopter started to sink. Both the crew and passengers evacuated the helicopter using normal exit. The nearby residents and police helped the rescue process and further movement to the hospital. There was no injury to any person on board and others. The incident was survivable.

### 1.16. Test and Research

The Engine oil samples obtained from both the engines were tested in Physical and Chemical Laboratory, Office of DGCA, New Delhi. There were no anomalies observed.

### 1.17. Organizational and Management Information.

M/s Lulu International Shopping Mall Private Limited is registered at Kochi, India. The aviation division of the company envisages operations of one twin engine helicopter in the

private category, providing for personal travel requirements of its directors and their personal guests. There are only two pilots in the organization.

## 1.18. Additional Information

### 1.18.1. Review of earlier flights operated by the crew set

The last four flights operated by the same crew set (involved PIC and Co-Pilot switching positions) was reviewed and compared with the incident flight and following were observed.

1. The crew used to activate Engine torque limiter function at startup.
2. Crew did not follow normal Checklist. Checklists items were carried out by memory.
3. Crew did not isolate themselves from the cabin communications by using ISO Call SWITCH.
4. The normal approach profiles of the flights were gradual decrease of speed and altitude, unlike the incident flight.
5. The maximum Rate of Descent recorded was 700 ft/m.

### 1.18.2. DGCA Operations Circular 04 of 2011 – Managing Disruptions and Distractions

This circular discussed the causes and consequences of interruptions and distractions. And also describes techniques for reducing and dealing with them.

Effect: - An error may occur if the attention of the flight crew is diverted while they are engaged in safety-critical tasks such as following SOPs or doing normal checklists or communications or monitoring or problem solving… this leads to

1. Failure to monitor the flight path, possibly leading to an altitude or course deviation or even CFIT.
2. Omitting an action and failing to detect and correct the resulting abnormal condition or configuration.
3. Non-adherence to SOP's.

In order to reduce:

1. Maintain a high level of interaction and communication among flight crew members.
2. Adhere to the Sterile Cockpit Rule & brief jump crew and passengers.
3. The most effective company prevention strategies and personal lines-of-defense involve strict adherence to SOPs, Operations golden rules, Standard calls, sterile cockpit rule, Recovery techniques such as: "Identify – Ask – Decide – Act", "Prioritize – Plan – Verify."

### 1.18.3. Vortex Ring State

Vortex ring state (VRS) is an aerodynamic condition which occurs when the rotor disc of the helicopter descends through its own rotor tip vortices, causing recirculation of the turbulent air. This leads to sections of the rotor blades stalling in an unpredictable manner and results in an overall loss of lift from the rotor and erratic handling of the helicopter.

As a result of these changed flow conditions, the lift produced by the rotor is massively reduced and the rate of descent of the helicopter is increased accordingly. By pulling on collective the effect is amplified.

A vortex ring state may be entered during any maneuver that places the main rotor in a condition of descending in a column of disturbed air and low forward airspeed. Airspeeds that are below translational lift airspeeds are within this region of susceptibility to vortex ring state aerodynamics

(Fig. 12: Vortex Ring State)

The following combination of conditions is likely to cause settling in a vortex ring state in any helicopter:

1. A vertical or nearly vertical descent of at least 300 fpm.
2. The rotor disk must be using some of the available engine power (20–100 percent).
3. The horizontal velocity must be slower than effective translational lift.

Situations that are conducive to a vortex ring state condition are attempting to hover OGE without maintaining precise altitude control, and approaches, especially steep approaches, with a tailwind component. The state can be ended either by switching to autorotation or by taking up horizontal speed.

Recovery from Vortex Ring State is a mandatory exercise in simulator session as per DGCA CAR.

### 1.19. Useful or Effective Investigation Techniques used

Nil

# 2. ANALYSIS

Analysis of the incident was mainly focused on

### 2.1. Serviceability of the helicopter:

On the day of incident, the helicopter had flown 225:47 Hrs TSN. The certificate of Airworthiness was issued on 21-01-2019 and was valid. Last major inspection carried out on the helicopter was '200 Hrs/ 6months' at 191:15 Hrs on 20-10-2020. Subsequently all lower inspections were carried out as and when it was due.

All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modification on this helicopter and its engine have been complied with as & when due.

There were no issues observed in the technical log, maintenance records and stored fault code data. There was no evidence that the helicopter was not maintained or certified in accordance with the current regulations. The investigation found no evidence of a technical defect.

From the above, it is inferred that the helicopter was completely serviceable with all valid documents, and is not a factor to the incident.

### 2.2. Flight crew background and training

Both the pilots have undergone initial helicopter training in Armed forces and have got sufficient level experience and flying hours in Defense as well as in Civil helicopters. The PIC is a DGCA approved Type Rated Instructor on AW-109 type of helicopter and the Co-Pilot is a DGCA approved Type Examiner on AW-109 type of helicopter. Both the crew had completed mandated trainings as prescribed in CAR. There were no earlier records of the crew involved in any incident or accident.

Due to COVID-19 pandemic and as per DGCA guidelines, the crew had undergone simulator training on helicopter instead of simulator wherein critical emergencies are only discussed and not practiced on actual helicopter. The crew had sufficient rest and no records indicate of fatigue factors affecting crew's performance.

Therefore, flight crew were adequately qualified to operate the helicopter.

### 2.3. Two Crew Operation

This helicopter was operated by both the crew on all flights under the command of either one of them. Both the pilots were duly qualified and had almost equal experience.

From the CVR analysis, it was observed that the crew did not isolate themselves from the cabin communications during the entire flight which could have been the source of distraction and also not maintaining sterile cockpit during critical phase of flight.

As per the crew statement, they carried out cockpit checks communicating with 'gestures'. They did not follow procedure of challenge and response while carrying out the checklist, this was also observed from CVR recording of their earlier flights.

## 2.4. Conduct of Flight

### 2.4.1. Flight Planning

The sector was planned for a flying time of less than 5 mins with local control of Garuda ATC.

The Departure and Arrival helipads belong to the parent company and both the pilots had earlier operated to these helipads. So, the crew were familiar with the terrain, approach path and profile for a VFR flight. The crew accepted the flight from the AME, carried out preflight checks and found no anomalies.

The helicopter was loaded within the limits and no anomalies observed in actual and calculated loading of helicopter for the incident flight. Hence, flight planning is not a factor to the incident.

### 2.4.2. Weather

Weather report obtained from Cochin Airport was conducive for the flight with rain on the flight path. CVR indicates that the Flight crew were aware of the rain on the flight path and have switched ON the windshield wiper before take-off.

From the above, it is inferred that the weather is not a factor to the incident.

### 2.4.3. Pilot handling of the helicopter

The flight crew handling of helicopter was analyzed by inputs from the flight recorders data and the statement of the operating crew. Flight Crew had activated Engine torque limiter function on ground, which limits the AEO torque produced by the engines to 220% (110% each) for the flight.

The flight was flown manually by the crew, as autopilot was not engaged during the flight. The flight was uneventful from take-off and up to the final left turn towards the Lakeshore helipad.

At 03:16:27 UTC, the helicopter pitch attitude was increased to $15^{o}$ and beyond. As engine torque demand was not increased, the (air)speed - IAS of the helicopter has slowed down from ~80 kts to 40 kts. Since it was not noticed and corrected in time, this resulted into an increased rate of descent.

Around 03:16:30, at 300 ft AGL, the pitch attitude was further increased above 15 deg and reached approx. 21 deg by which the IAS of the helicopter fell below 20 kts in less than 3 seconds. This increase in pitch attitude and corresponding speed reduction lasted for 14 seconds and was not noticed by the crew, as they were focused on the ‘moving rain patch’ and ways to avoid it.

[Increase in pitch attitude decreases the speed of the helicopter and the helicopter starts to lose altitude. In order to keep the helicopter flying in same altitude, more power is needed. If more power is not provided, the helicopter descends faster]

The First Officer who was pilot monitoring did not monitor flight parameters and did not make any callout to the PIC for taking corrective action. Pilots failing to isolate themselves from passenger communication and not maintaining sterile cockpit might have affected their ability to identify and address the situation promptly.

At around 200 ft AGL, the descent rate of the helicopter became high (peaked at ~2000 fpm) and helicopter started sinking, for which the PIC applied full collective in order to recover the helicopter from the sink. The engine responded and the torque increased immediately and reached a cap of 220% AEO as torque limiter function was ON. This caused the fuel flow to decrease which reduced the rotor speed below 96% triggering ROTOR LOW warning. Since the pitch angle was more than 21 degrees coupled with limited engine power caused the helicopter to enter into Vortex Ring State and helicopter became uncontrollable. This further caused, the rate of descent to increase and in the next 4th second, the helicopter impacted the ground even though the engine power was available and the collective was at 100% Full position.

The Engine torque limiter is an On-demand function and activation and deactivation is left to pilot's judgment for manual flying. Flight crew who anticipated rain and weather condition during approach could have deactivated the limiter at appropriate time so that full torque would have been available for the engine. M/s Leonardo Company and P&W are of the opinion that, if torque limiter function was not activated, the engine torque would have gone beyond 220 % and up to its highest limit of 324 % AEO, and the helicopter would have recovered from rapid descent.

All the helicopter systems and the engines responded as per design and as per the crew inputs, and, there was no evidence of 'loss of power' as reported by the crew.

Therefore, from the above, it is inferred that the handling of the helicopter is a primary factor to the incident.

# 3. CONCLUSION:

## 3.1. Findings

1. The helicopter was certified, equipped and maintained in accordance with existing regulations and approved procedures.
2. At the time of incident, there was no recorded, deferred defects on the helicopter.
3. The helicopter was operated within the Centre of Gravity and Weight limits
4. The flight crew were properly licensed and qualified to conduct the flight, and their FDTL were within the limits.
5. The flight crew were conversant with the route and terrain.
6. The flight crew carried out Pre-flight medical before the flight and was tested negative for influence of alcohol.
7. PIC was Pilot Flying and Co-Pilot was Pilot Monitoring. The helicopter was flown manually by the PIC.
8. The entire conversations of crew and ATC were overlapped with inter-cabin conversations (passenger conversation) as the crew did not isolate themselves from the cabin communications, thereby not adhering to Sterile cockpit.
9. Flight crew activated the Engine torque limiter before take-off.
10. The activation of Engine torque limiter was left to pilot's judgement for manual flying. The limiter was found activated on earlier flights.
11. During approach, Crew maneuvered the helicopter with unusual pitch attitude from an almost level condition to $21^{o}$. Due to lack of appropriate compensation to the Engine Torque, resulted in progressive reduction of IAS.
12. This was not noticed by the flight crew, and not corrected in time, the helicopter started losing altitude rapidly.
13. Both the flight crew were unaware of helicopter's continued descend and RoD peaked ~2000 ft/min at very low altitude.
14. First Officer (pilot monitoring) did not monitor flight parameters during critical phase of flight.
15. Upon losing considerable height, PIC applied full collective resulting in immediate increase in torque by both the engines, which reached the 220% cap set by Engine Torque Limiter. This caused Main rotor speed to droop activating ROTOR LOW warning.
16. Helicopter had entered into Vortex Ring State, which makes recovery difficult, with the remaining height available.
17. Weather was not a factor to the incident.
18. There was no post impact smoke or fire.
19. There was no evidence of 'loss of power' as reported by the crew.

### 3.2. Causes

The Pilot maneuvered the helicopter with unusual high pitch attitude with low torque setting, resulting into high rate of descent at low altitude. Subsequently, the helicopter entered into Vortex Ring State and the pilot lost control of the helicopter and the helicopter impacted the ground.

Non adherence to Standard operating procedures by the crew and lack of situational awareness is the contributory factor to the incident.

## 4. Safety Recommendations

Nil

Veeraragavan K
Air Safety Officer &
Investigation in-charge: VT-YMA

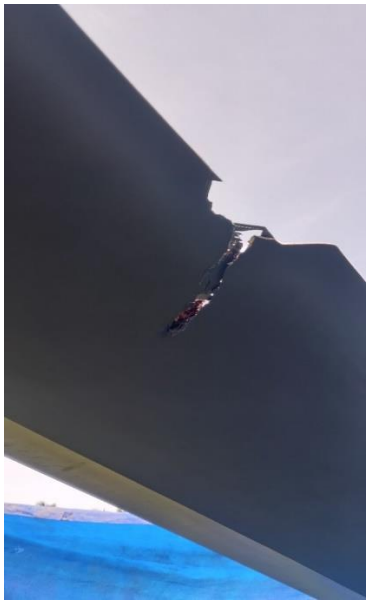
Date : 26th Oct 2021
Place : Chennai

# Annexure 1: Damage Assessment photos

Fig. 13: Helicopter final resting position

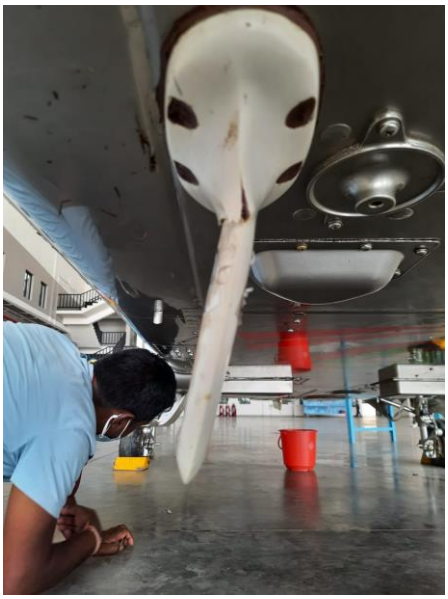
(Fig. 14: Cockpit view)

(Fig. 15: Nose Landing Gear doors twisted and broken)



(Fig. 16: Main Rotor Blade s/n-AW1812 found cracked near Trim Tab)

(Fig. 17: Both the chin bubbles (cockpit lower glass) found broken)



(Fig. 18: VHF Antenna broken)

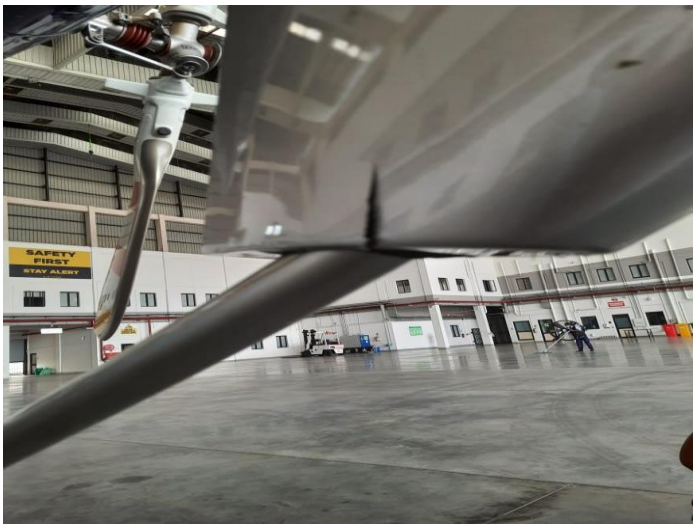
(Fig. 19: VHF 2 Antenna broken)


(Fig. 20: Utility accumulator access panel Deformed)

(Fig. 21: Both Fuel Booster PUMP Sump Panel found Deformed)

(Fig. 22: LH& RH Sponson Landing/taxi Light Glass found Broken)

(Fig. 23: Belly, alongside vents line& Drain lines found Deformed)




(Fig. 24: Lower Fin adjacent to tailskid found Deformed& Cracked)

***END***