

FINAL INVESTIGATION REPORT ON
ACCIDENT TO M/s HIMALAYAN HELI
SERVICES PVT. LTD. AS 350 B3
HELICOPTER VT- JKB ON 23-11-2015
AT KATRA, JAMMU

COMMITTEE OF INQUIRY VT-JKB

K Ramachandran
Air Safety Officer
AAIB
Member

Capt. J P S Kniggar
Ops Member

Yash Pall
Chairman

Foreword

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 03 of Aircraft (Investigation of Accidents and Incidents), Rules 2012, the sole objective of the investigation of an accident/incident shall be the prevention of accidents/incidents and not apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of such future accidents/incidents could lead to erroneous interpretations.

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**FINAL INVESTIGATION REPORT ON ACCIDENT TO M/S
HIMALAYAN HELI SERVICES PVT. LTD. AS 350 B3 HELICOPTER
VT- JKB ON 23-11-2015 AT KATRA, JAMMU.**

1.	Helicopter	Type	Ecureuil AS 350 B3
		Nationality	Indian
		Registration	VT-JKB
2.	Owner	M/s Himalayan Heli Services Pvt. Ltd.	
3.	Operator	M/s Himalayan Heli Services Pvt. Ltd.	
4.	Pilot – in –Command		CPL (H) Holder
	Extent of injuries		Fatal
5.	Date & Time of accident		23-11-2015; 0725 UTC.
6.	Place of accident		Katra, Dist : Riasi (J& K)
7.	Co-ordinates of accident Site		Lat 32° 59' 22" N, Long 74° 55 ' 35" E AMSL: 2720 feet.
8.	Last point of Departure		Katra Helipad
9.	Intended landing place		Sanji Chhat Helipad
10.	No. of Passengers on board		06
	Extent of injuries		Fatal
11.	Type of Operation		Shuttle service under NSOP operations
12.	Phase of Operation		Cruise / climb
13.	Type of accident		Bird Strike/ Fatal

(All timings in the report are in UTC)

SYNOPSIS:

AS350B3 Helicopter VT-JKB, owned and operated by M/s Himalayan Heli Services Pvt. Ltd, was involved in an accident at Katra, while operating flight from Katra Helipad to Sanji Chhat Helipad, on 23.11.2015. The helicopter was under the command of a pilot holding a valid CPL(H). There were a total of 06 passengers on board the helicopter.

The helicopter took-off from Katra Helipad at approximately 0722 UTC. While en-route to Sanji Chhat helipad the helicopter, suddenly turned back probably to make an emergency landing, post bird strike, towards a nearby open space. The helicopter during descent hit electric cables at the edge of an open space. The Helicopter got entangled in the electric cables, toppled, impacted the ground in an upside down condition and caught fire. The helicopter was immediately engulfed in a ball of fire. The accident took place at around 0725 UTC.

The police and fire tenders reached the accident site immediately and extinguished the fire. All the occupants of the helicopter received fatal injuries. The bodies of the victims were taken to a nearby hospital for a post mortem and other necessary formalities. A dead partially burnt vulture was found along with the wreckage.

Ministry of Civil Aviation constituted a Committee of Inquiry to investigate the cause of the accident under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2012 comprising of Sh. Yash Pall, as Chairman, Capt. J. P S. Kniggar, and Sh. K. Ramachandran, Air Safety Officer, AAIB, as members, vide MoCA order No. AV-15029/116/2015- DG.

1. FACTUAL INFORMATION:

1.1 History of Flight:

AS350B3 Helicopter VT-JKB owned and operated by M/s Himalayan Heli Services Pvt. Ltd, was operating shuttle flights from Katra helipad to Sanjhi Chhat helipad, as per the contract with Mata Vaishno Devi Shrine Board.

On the day of accident, the helicopter VT-JKB had carried out 24 uneventful shuttles, ferrying passengers to/from Sanjhi Chhat helipad (Vaishno Devi Shrine). The accident happened during the 25th shuttle of the day. The first 15 shuttles of the day on the helicopter VT-JKB were operated by another pilot of the operator. There was no snag reported by the pilot. Thereafter, the next 09 shuttles on the helicopter VT-JKB were flown by the deceased pilot and there was no snag reported before the accident flight. As per the statements of the pilots who were operating in that area, bird activity was observed at that time of the day in the vicinity of the flight path.

The helicopter took-off from Katra Helipad at around 0722 UTC with 06 passengers on board. As per procedures, the deceased pilot made a take-off call on RT before departure. As per the statements of eyewitnesses, while en-route to Sanjhi Chhat the helicopter was seen to turn back and descend, probably to make an emergency landing towards a nearby open space, post bird strike. During descent and while approaching the open space, the helicopter hit electric cables at the edge of the open space, got entangled with them and impacted the ground upside down. The helicopter immediately caught fire. The accident took place at approximately 0725 UTC. Eyewitnesses also stated that they had seen black smoke after the helicopter descended and disappeared. Meanwhile the other helicopter VT-GVJ belonging to M/s Global Vectra Helicopter Ltd., having taken-off from Sanjhi Chhat helipad, pilot received a RT call from ground asking to confirm if he had heard any RT call from helicopter VT-JKB. On receiving a 'Negative' reply, he was asked to look out for the black smoke to the left of its flight path. The pilot of VT-GVJ reported that helicopter VT-JKB was lying on the ground upside down, engulfed in ball of fire and thick black smoke. The police and fire tenders reached the accident site immediately and extinguished the fire. All the occupants of the

helicopter received fatal (burn & impact) injuries. The bodies of the victims were taken to a nearby hospital for a post mortem and other necessary formalities.

After recovery of the bodies from the helicopter wreckage, a dead vulture (in a partially burnt condition) was found underneath the wreckage on the right side of burnt cabin area of the toppled helicopter wreckage. One wing of the vulture was found approximately 80 meters away from the wreckage. The helicopter cockpit and cabin were completely burnt.



Google Earth Ariel View of Accident Site of VT-JKB

1.2 Injuries to Persons :

Injuries	Crew	Passengers	Others
Fatal	01	06	NIL
Serious	NIL	NIL	NIL
Minor/None	NIL	NIL	NIL

1.3 Damage to Helicopter:

The helicopter was completely destroyed. The tail boom severed from the main structure after impact and was substantially damaged.

1.4 Other Damages: The electric cables entangled with the helicopter had snapped.

No other damage was observed.

1.5 Personnel Information:

1.5.1 Pilot- in- Command

Age	43 years
License	CPL (H)
Date of License Issue and Valid up to	14/12/2005 & valid upto 13/12/2015
Category	Helicopter
Class	Single Engine/Land
Endorsements as PIC	Aloutte III/Chetak/SA315B/Lama/AS350B3
Date of Joining Company	January 2006
Date of Endorsement as PIC on AS 350 B3	10.07.2009
Instrument Rating	Nil
Date of RTR Issue and Valid up to	27/04/2010, valid for lifetime
Date of FRTOL issue & validity	14/12/2005 & valid upto 13/12/2015
Date of Med. Exam & validity	09/06/2015 & valid upto 08/12/2015
Date of Route Check	07/03/2015
Date of Last Proficiency Check	15/08/2015
Date of English language Proficiency & Valid up to	08/03/2011 & valid upto 07.03.2017
Date of last CRM	20/11/2015
Date of last Monsoon training	07/05/2015
Date of Dangerous Goods Awareness Training	18/12/2013
Date of last Refresher/Simulator	06/12/2013/ No Simulator
Training for Critical Emergencies on Simulator	Not carried out*
Training for Critical Emergencies on Helicopter	06/12/2013
Familiarity with Route/ Airport flown for last 12 months and since joining the company.	Very Familiar & was regularly flying at Katra, 180 hrs in last 12 months.
Total flying experience	5949 Hours
Total Experience on type	2367 Hours
Total Experience as PIC on type	2014 Hours

Last flown on type	12/11/2015
Total flying experience during last 01 Year	481 Hours
Total flying experience during last 180 days	245 Hours
Total flying experience during last 90 days	88 Hours
Total flying experience during last 30 days	14 Hours
Total flying experience during last 07 Days	Nil
Total flying experience during last 24 Hours	Nil
Rest period before the flight	11 Days
Date last flown ELO & duration other than check/refresher	18/04/2015

Note: The above details are based on the data provided by the operator as the pilot log book was not available.

As per the data provided by the operator.

- The pilot last flew in Katra on 12.11.2015. After the break of 11 days the pilot returned to Katra on 23.11.2015 and was straight away rostered for normal operation of the helicopter on the same day.
- Periodic simulator training was not carried out by the pilot as per the requirements of CAR.

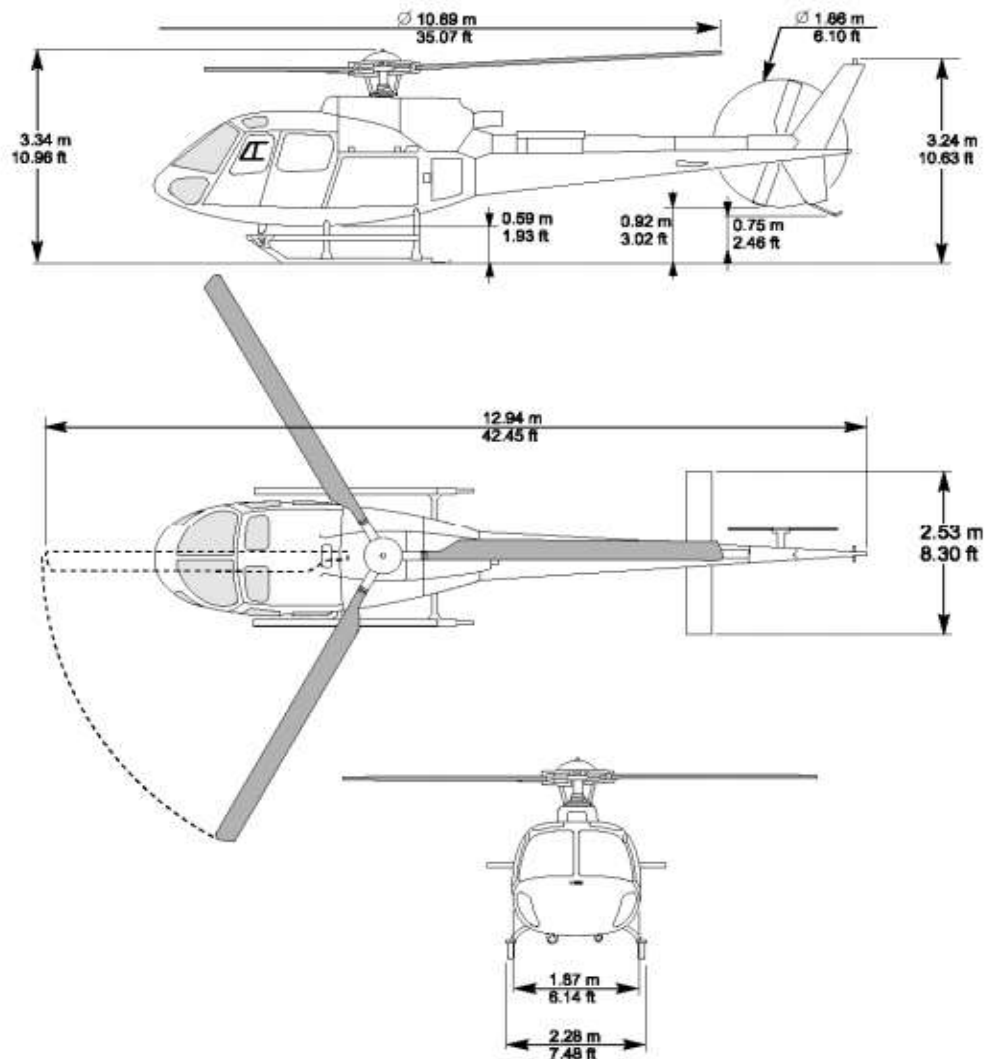
1.6 Helicopter Information:

1.6.1 General Description

Ecureuil AS350 B3 helicopter VT-JKB is a single engine helicopter manufactured by M/s Eurocopter, France (now Airbus Helicopters). The helicopter is certified in transport category, for day operation under VFR. The maximum operating altitude of this helicopter is 23,000 feet density altitude and maximum all up weight is 2250 Kgs. Its length is 12.94 meters, width is 2.28 meters and height is 3.34 meters. Its seating in high density configuration is 01 Pilot and 06 passengers. It has three main rotor blades and two tail rotor blades.

The structure of the helicopter AS350 B3 is based on a Beam type modular construction. The main structure supports the main transmission components (Main Gear Box and Rotor), skid, cabin floor, rear structure and encloses the fuel tank. The entire canopy is made of polycarbonates. The bottom structure, supporting the cabin, is of a canti-lever type and forms an

extension of the body structure. Beams, reinforced by cross members are bolted on the main structure lateral beams and support the skids at forward end. The rear structure consists of 3 frames, connected by beams. The rear and forward frames support the engine. The tail boom is bolted to junction frame no 3 and can be easily removed. The rear structure also contains a baggage compartment. The tail boom is made of Aluminium Alloy and consists of circular frames covered by an outer skin. Assembly rigidity is ensured by sheet metal stiffeners.

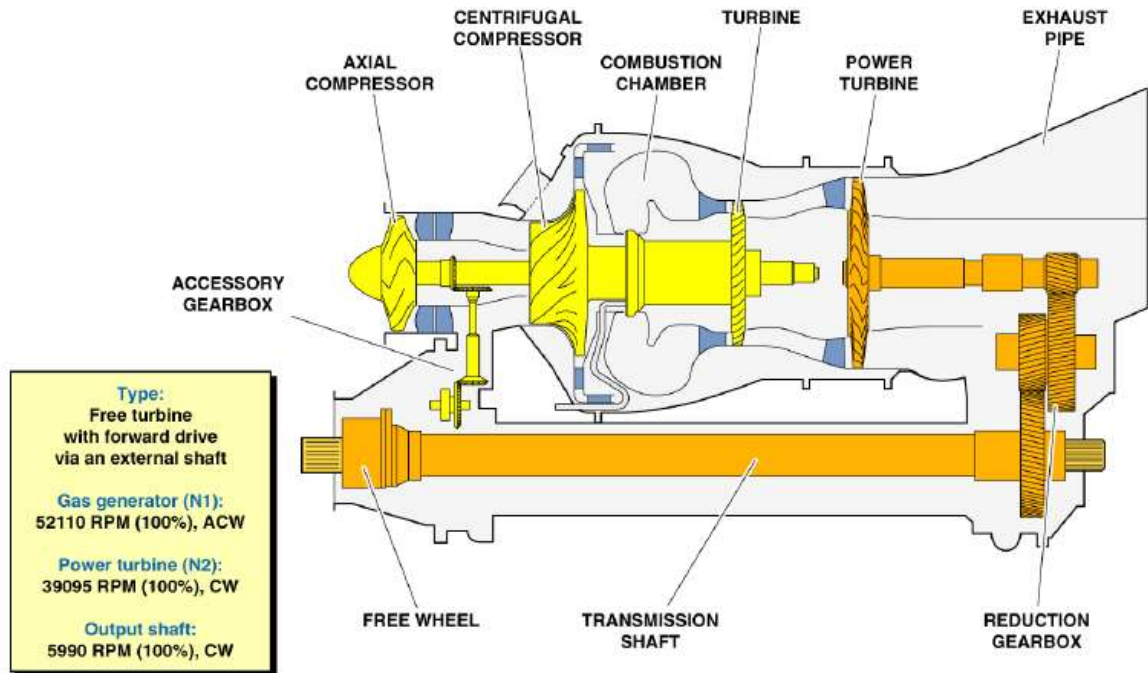


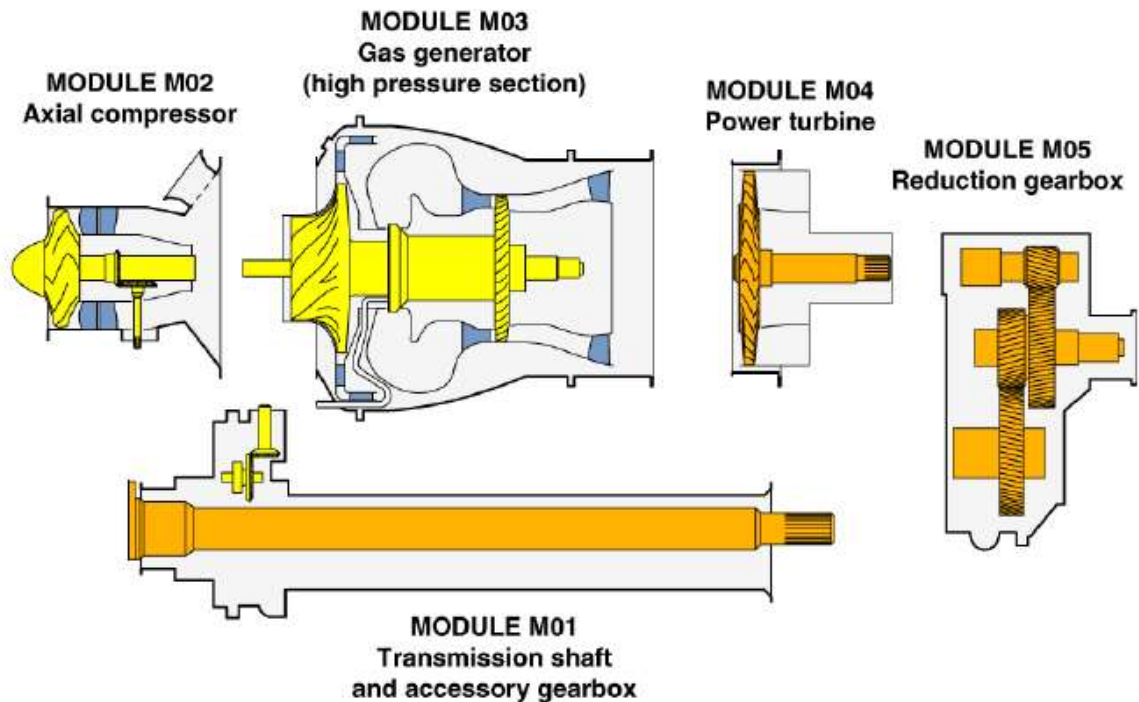
Three- view drawing of AS 350 B3 helicopter

AS 350 B3 Helicopter is powered by a single Turbomeca Arriel 2B1 free-turbine turbo shaft engine having a maximum take-off power of 632 kW (8475 hp) and features a modular design. It is located in a separate fireproof compartment after the MGB and above the rear cargo compartment. It is connected to the MGB by a shaft mounted between two flexible

couplings. The rotational speed of the gas generator is determined by the rate at which fuel is burned in the combustor. Gas generator exhaust gases drive a single-stage power (free) turbine, which drives a reduction gear assembly. Torque is transferred forward through a power turbine shaft to an accessory gearbox mounted at the front of the engine.

The Arriel 2B1 engine is a turboshaft engine with a single-stage axial compressor, a single-stage centrifugal compressor, an annular combustion chamber, a single stage high pressure turbine, a single stage power turbine, and a reduction gearbox, with a nominal output at 5990 rpm. The engine is rated at 557 kW (746 shp) at take-off power and 543 kW (728 shp) at maximum continuous power. Its dry weight is 132 kg. The ignition system is one of low tension, high energy, and includes one high-energy generator, two injectors and two igniters. Engine start is via an electro-valve.





The Arriel 2B1 engine is two channel FADEC controlled, modular free-turbine, is composed of five modules:

1. Axial Compressor Module (single-stage with bleed valve)
2. Gas Generator Module
 - A centrifugal compressor
 - An annular combustion chamber
 - A single-stage gas generator turbine
3. Free Turbine Module
4. Reduction Gear Module (reduces the free turbine speed from 39156 down to 6000 rpm)
5. Output Shaft Module (Transmits power to the MGB and accessory drive couplings and contain free wheel)

VEMD

The VEMD (Vehicle & Engine Management Display) is installed on the instrument panel of the B3 designed to manage in function of the selected helicopter essential and unessential vehicle and engine data can be glanced by the pilot on dual LCD screen.

- the display of vehicle parameters,

- the display of engine parameters,
- the computation and display of engine first limitation
- the computation and display of weight related to performance data,
- the display of engine performance checks,
- the display of FADEC data,
- the computation and display of the number of engine cycles.
- includes built-in tests that help check its own operation and that of related avionic systems.

Displayed engine and airframe parameters:

- A rectangular cross-hatched flag: bleed valve open.
- "NG and DNG": Ng and DN_g (gas generator rating, deviation with respect to Ng at Max Take-Off Power in)
- "T4": "T4" (free turbine input temperature).
- "TQ": "TQ" (engine torque).
- "FLI": First Limitation Indicator.
- "OAT": Outside Air Temperature.
- "P2": P2 air bleeding.
- "FUEL QTY": Fuel quantity.
- "ENG OIL PRESS": Engine oil pressure.
- "ENG OIL TEMP": Engine oil temperature.
- "BUS": Bus bar voltage.
- "GEN": Generator current.
- "START": Starter current.
- "FUEL F": Fuel delivery and endurance. If optional fuel flow sensor is installed.

ECU (Engine Control Unit)

Description and Operation of the Engine Electronic Control Unit

A. General

The Engine Electronic Control Unit (E.E.C.U.) controls and monitors the engine operation. The E.E.C.U. is installed in a helicopter compartment.

(1) Main characteristics

The main characteristics of the E.E.C.U. are:

- A dual-channel digital electronic
- A redundant electrical supply: 28 volts.

(2) Main components

The main components of the E.E.C.U. are:

- Four electrical connectors
- Two electronic modules.

B. Functional description

E.E.C.U. lay-out

The E.E.C.U. includes:

- A programmable controller
- An operating software.

The controller manages the acquisition, the actuation and the dialogue necessary for the E.E.C.U. to carry out its functions. The controller relays the information to the software. The software uses the services and the resources of the programmable controller. The sub-programs launched by the software can assimilate the services of the controller. The controller is of the dual-channel type. It has a function which freezes the stepper motor if there is an electronic failure. It has an atmospheric pressure sensor (P0). The controller makes the interface between the aircraft and the system components. The interface connectors are different. The interconnection harness makes the electrical connections. Some cables are shielded. One of the ends of the shielding connects it to the earth.

The ADA

The engine electronic control unit (E.E.C.U.) controls and monitors the engine operation. These maintenance aid functions are:

- The cycle counting

- The counting of the use of the OEI ratings
- The fault indication.

(1) Cycle counting

The E.E.C.U. has a device which counts and memorizes:

- The gas generator cycles
- The power turbine cycles.

The displayed counters have a capacity of 1,000 cycles. When the counter displays the maximum value, it is automatically reset.

(2) Fault indication

The fault indication system has a fault indication device which warns the pilot of the fault acquisition time.

BRAKES

Skid type of landing gear is used on the helicopter .Therefore there are No parking brakes, or pedal brakes, installed for helicopter operation.

Main Rotor Brake is installed for stopping of the Main Rotor Blades at a predetermined stage, during shutting down of helicopter.

1.6.2 General Information

AS350 B3 helicopter VT-JKB S/No. 7048 was manufactured in the year 2010. The helicopter was owned and operated by M/s Himalayan Heli Services Pvt. Ltd. Certificate of Registration No.4197, under Category ‘A’ which was issued in the name of M/s Himalayan Heli Services Pvt. Ltd. on 03.03.2011.

The certificate of Airworthiness Number 6306 was issued under “Normal” category sub-division “passenger/aerial work” issued by DGCA on 07.03.2011 and specifying minimum crew as 01 with lifetime validity. ARC Ref No. DDG/NR/ARC/2015/203 was valid upto 08.10.2016. Helicopter VT-JKB had logged 4171:01A/F Hrs and 62219 landings before accident.

The helicopter and its Engine were maintained as per maintenance program consisting of both calendar and Flying Hours / Cycles based maintenance. The maintenance program was approved by the Office of the DDG, DGCA, Delhi. On line maintenance

data is utilised by the Operator. The helicopter was having Aeromobile License, No. A-042/005-RLO (NR) and is valid up to 31.12.2018.

600 hours inspection was carried out on 10.07.2015 at 3743:21 A/F hours and 53505 landings. 1000 Hrs (out of phase) Inspection schedule was carried out at 4138:56 Hrs on 15.11.2015 at Katra. Renewal of ARC was issued on 09.10.2015 and was valid upto 08.10.2016. Thereafter the helicopter flew 127:46 hrs before the accident flight.

The helicopter was last weighed on 08.10.2015 at Katra and the weight schedule was recomputed on 12.10.2015 and duly approved by the O/o DDG (NR), DGCA, Delhi on 27.10.2015. As per the approved weight schedule, the Empty weight is 1264.01 Kgs, Maximum Fuel capacity is 540 litres, Maximum permissible load with 1 Pilot, Fuel and Oil tank full is 478.94 Kgs. Empty weight CG is 3.56 meter aft of reference in land configuration. There has not been any major modification affecting weight & balance since the last weighing. The last fuel microbiological test was carried out on 29.07.2015 and colony counts were within acceptable limits.

Pre-flight inspection was carried out on 23.11.2015 at Katra by the duly authorised certifying staff, before flight. Helicopter carried out uneventful 03 hrs of flying & 24 landings, before the accident flight, on the day of accident. Refuelling was carried out at Katra and 129 litre of fuel was uplifted. At the time of take-off from Katra there was total of approximately 140 litres of fuel for the flight and the helicopter had an endurance for approximately 01.00 Hour. The load and trim sheet of the first flight was prepared and centre of gravity found within limit.

Turn Around Inspections are carried out by the duly authorised certifying staff, as per approved Turn Around Inspection schedules and all the higher inspection including checks/inspection were carried out as per inspection schedules based on the manufacturer data. All schedules are approved by the Continued Airworthiness Manager (CAM). All the applicable SB's, AD's and DGCA mandatory Mods were complied.

As per the store records submitted by the Operator, last component replaced on helicopter VT- JKB was aircraft battery which was replaced on 30.09.2015.

ENGINE

The AS350B3 helicopter VT- JKB is fitted with one Arriel 2B1 engine S/N 23003 manufactured by Turbomeca. This Engine had logged 7288:47 Engine Hrs and 15780:88 cycles respectively, as on 23.11.2015. The last major inspection carried out on Engine was 150 Hrs/12 Months, on 23.10.2015 at 7156:19 Engine Hours.

MAIN ROTOR BLADES

The AS350 B3 helicopter VT-JKB was fitted with 03 Main Rotor Blades, details are as below:

S/N	PART NO.	SERIAL NO.	COMPONENT HRS
1.	355A11003004	32754	4171:01
2.	355A11003004	32800	4171:01
3.	355A11003004	32815	4171:01

TAIL ROTOR BLADE

S/N	PART NO.	SERIAL NO.	COMPONENT HRS
1.	355A12-0050-10	16219	1783:16

1.7 Meteorological Information:

There is no MET office at Katra or Sanjhi Chat. The weather is generally taken from Udhampur/Jammu. During the time of accident the weather reported was, visibility fine with winds 225°/04 kts, Temperature 29°C, pressure 1017 hPa.

1.8 Aids to Navigation:

The helicopter is only VFR cleared and is equipped with necessary navigation aids as per regulations e.g. ADF, VOR, ATC Transponder and GPS. Helicopter was flying VFR flight from Katra helipad to Sanjhi Chhat Helipad.

1.9 Communication:

At the time of accident, the helicopter was not in contact with any ATC, since it is not required as per the Joint SOP for helicopter operations from Katra to Sanjhi Chat helipad. As per the SOP, the helicopters will report position at each designated point by giving RT calls maintaining height bands which would be acknowledged by other helicopter. Before take-off a RT call was made by the pilot of VT-JKB.

1.10 Aerodrome Information:

Katra Helipad is located in Katra, Dist Riasi, Jammu and Kashmir and is used for helicopter operations for ferrying pilgrims visiting Shri Mata Vaishno Devi Shrine. The helicopter service is provided from Katra helipad to Sanjhichat Helipad, which is about 2 Kms from the shrine. The helipad is owned by Shri Mata Vaishno Devi Shrine Board. Katra and Sanji Chat helipads are constructed out of concrete and are marked with a letter "H", so as to be visible from the air. 03 helicopters can be parked at Katra helipad and 01 helicopter can be parked at Sanjhi chat helipad at a time. The emergency services covering fire and medical are available at both the helipads.

The details of the helipads are:

Helipad	Co-ordinates	Dimensions	Take-off/Approach Direction	Helipad Elevation
Katra	32° 59' 17" N 74° 56' 52" E	58 m x 38 m	North West/ South East	2900 feet
Sanjhi chat	33° 01' 17" N 74° 56' 20" E	45 m x 29 m	360° North/030° East	6000 feet

1.11 Flight Recorders:

Cockpit Voice Recorder (CVR) and Digital Flight Data Recorder (DFDR) were neither fitted nor required as per relevant Civil Aviation Requirements.

As source of useful stored data, the VEMD and ECU of the accident helicopter were retrieved from the wreckage for further examination. Relevant data were extracted and used for investigation purpose.

1.12 Wreckage & Impact Information:

While en-route to Sanjhi Chhat the helicopter was seen to turn back, probably to make an emergency landing, post bird strike, towards a nearby open area. While descending the helicopter hit the electric cables (which were running through the edge of the open area) and got entangled with them. The helicopter toppled and impacted ground in an upside down condition. The helicopter caught fire and the cabin & cockpit area were completely burnt and destroyed. The helicopter had settled with both skids in the air facing upwards, and nose facing south. The helicopter fell short of the open area and the final resting position of the helicopter was at the corner of the open area between two electric poles. Broken Electric cables were found under and around the wreckage. While inspecting the helicopter wreckage and the accident site, it was observed that the helicopter wreckage and its damaged parts were confined to its final resting position and there was no evidence of disintegration of helicopter part(s) in flight.



The helicopter after impact with ground engulfed in a ball of fire



Helicopter lying upside down with skids facing upwards (Final resting position)



Damaged Tail boom (severed from the burnt fuselage).

The Tail boom was severed from the burnt fuselage and was damaged but not burnt. The tail rotor drive shaft was found broken at some places. The tail rotor gear box was still attached to the tail boom.



Broken electric cables were found under the wreckage and around it.





One of the tail rotor blades severed from the tail rotor hub



Tail rotor drive shaft was found broken



The cockpit instrument panel was completely damaged along with the instruments.

Most of the cockpit instruments were substantially damaged and partially burnt making it difficult to take proper readings. The altimeter was reading 2512 feet with QNH set to 1018 hPa.





Two main rotor blade was substantially damaged and one was completely burnt

The Main Rotor Blades were found damaged and partially burnt. The leading edge of one of the blades was found dug into the ground, with broken electric cable entangled around it and another blade was found substantially damaged and burnt.

All the electrical, navigation and communication equipment were completely destroyed due to fire.

Cabin and Interiors

Helicopter impacted the ground upside down and caught fire. The cabin was completely smashed and broken, the doors and windows were smashed and mangled. All the occupants, seats, interior, including trim, were burnt due to extensive fire. All the seat belts and harness were partially burnt and had to be cut to remove the bodies including that of the pilot. A carcass of a burnt vulture was found inside the burnt cabin.

The instrument pedestal, including gauges and communication equipment were smashed, burnt and destroyed. The VEMD was damaged and partially burnt.



Damaged Main Rotor Gear Box

Drive Train and control surfaces

The helicopter having crashed upside down, the main rotor head dug into the ground and was probably the first point of impact with the ground. The main rotor blades were broken and one blade was burnt. The main rotor head, starflex and swashplate were smashed and burnt.

The main gear box was damaged and burnt. Due to extensive fire, no traces of MGB oil and hydraulic fluid were observed.

The tail rotor gear box was still attached to the severed tail boom. The tail rotor drive shaft was found twisted and broken at more than one place. One of the tail rotor blades was severed from the hub and the other was found intact but partially burnt and damaged.

Fuselage & under carriage

The fuselage was completely smashed and burnt. The tail boom had separated from the fuselage, Structural members were damaged due to impact and fire. The under carriage (skids) were found pointing upwards and attached to the burnt fuselage. Cross Tubes were found damaged due to burning and heat, but not broken .The left skid was found broken near the front cross tube.

Engine

The engine was completely damaged. Due to impact and burning the engine mountings were not found in its actual position, the coupling to the drive shaft was still connected. Due to extensive fire the engine was externally burnt. Electrical Equipment and indicating system wires/cables were burnt. Due to impact, the exhaust ducts and intake, were severely damaged. The Combustion case was found damaged and mangled. Fuel pipelines and other pipelines, between the airframe and the engine, were severed. The engine oil tank was burnt and destroyed. Due to extensive fire, no trace of fuel or engine oil was observed on or around the engine.



Damaged and externally burnt engine

The engine was removed from the wreckage and transported to the O/o AAIB, New Delhi for further detailed examination. The engine was dismantled, under the guidance of BEA representatives and a type rated AME. The following damages were observed.

- Air Intake and compressor intake casing found damaged, as a result of impact and the blades were also found damaged.
- Bleed Valve was found broken from the casing attachment point.
- Most of the fuel and oil pipes were found distorted and crushed.
- Fire harness, engine harness and connectors were found still in place, however, some connectors were found burnt.
- Exhaust pipe crushed over module 5 due to impact.
- Magnetic plug Module 1 removed and found in good condition.
- Magnetic Plug Module 5 removed and found to be in good condition.
- Engine electrical magnetic plug removed and found to be in good condition.
- All the blades of the power turbine were broken and 1/3rd of them were missing. There were no signs of overheating. Blade rotation was possible with slight noise.
- Power turbine blades were off centred and was found rubbed against shroud.
- Shroud was damaged on one side.
- Oil clog indicator was not popped out.
- Oil filter was opened and found to be in good condition, no metal particles or dirt found.
- Fuel filter was opened and found to be in ok condition with a slight amount of dirt which was normal. Clog indicator was popped but damaged inside.
- HMU was found broken from attachment point. Metering actuator was found separated. EBCAU opened from HMU and shaft was found to be ok.
- Reduction gear module was removed. Torque nut marking was found misaligned.
- HP turbine was found to be ok. There was no rupture, however slight tip rub was found.

Engine Controls

The engine controls in the cockpit were completely smashed and burnt. It was not possible to trace the continuity/serviceability of the control linkages and the indication gauges.

The ECU (Engine Control Unit) was found in partially burnt state. The unit was sent to BEA, France for retrieval of data.

ELT

No locator transmission was reported by ISRO, therefore it is indicated that ELT failed to transmit after impact.

All the other equipment (hydraulic system components, techo –gene etc.) were found damaged and burnt.



Carcass of vulture found in partially burnt condition

Carcass of a dead and partially burnt vulture was found underneath the wreckage, which was lifted to recover the bodies of the deceased. It was found at right side of the toppled and burnt cabin area of the wreckage.

1.13 Medical & Pathological Information:

The pilot had undergone pre-flight medical and Breath analyzer test prior to operating the first flight of the day and the pilot was found not to be under the influence of alcohol.

After the accident, the body of the pilot and the passengers were sent to J & K Health Department, Directorate of Health Service, Jammu for post-mortem examination. As

per the post mortem report the whole body of the pilot was burnt and charred. The cause of death for pilot was determined as Cardio-pulmonary failure & haemorrhage resulting from multiple injuries & burns.

The cause of death, determined for all the other passengers, was also the same as that of the pilot.

1.14 Fire: There was extensive post impact fire.

1.15 Survival Aspects: The accident was not survivable.

1.16 Test and Research:

1.16.1 Engine Teardown Inspection

The accident helicopter engine was retrieved from the wreckage at accident site and was sent to O/o AAIB, New Delhi for further examination.

Engine tear down inspection was carried out at AAIB facility, by BEA representatives in presence of AAIB officials and officials from M/s Himalayan Heli Services Pvt. Ltd. on 08.12.2015.

Observations made during the tear down inspection are as follows:

Large sections of the engine were covered with soot deposits due to the post-crash fire.

Module 1 (Accessories Gearbox and Transmission Shaft)

The link tube was bent and distorted in the area of the rear engine support due to an important (Heavy) vertical force. The front support flange was distorted and it was ripped on its side thus leaving a hole and torn metal.



Module 2 (Axial Compressor)

The Gas Generator could not be rotated by hand. The casing was distorted and punctured in the upper part. All the blades of the axial compressor wheel were damaged and they had lost approximately a quarter of their height due to rubbing with the distorted casing. Such a level of damage indicates that the Gas Generator was rotating with power when the casing was crushed.



Module 3 (Gas Generator)

The module 3 casing was locally distorted and twisted. The engine was disassembled to reveal the High Pressure turbine. It was in good condition with only light tip rubbing. The blades were lightly splattered with shiny speckles indicating the ingestion of soft metallic FODs. Similarly, speckles could be seen on the Nozzle Guide Vanes' trailing edges. Such speckles originate from the ingestion of soft metallic FODs which subsequently melt when they reach the combustion chamber, thus indicating that the combustion was established in the combustion chamber at the time of the crash.



Module 4 (Power Turbine)

The module 4 appeared externally intact with local soot deposits. Once separated from the rest of the engine, it could be rotated by hand. Rubbing and some sticky points could be felt. Inside, the examination of the Power Turbine wheel showed that the bearing housing was no longer centred. It appeared to have moved in the vertical direction with the engine upside-down. Such damage can only originate from a very high vertical force and thus corresponds to the moment of the crash.

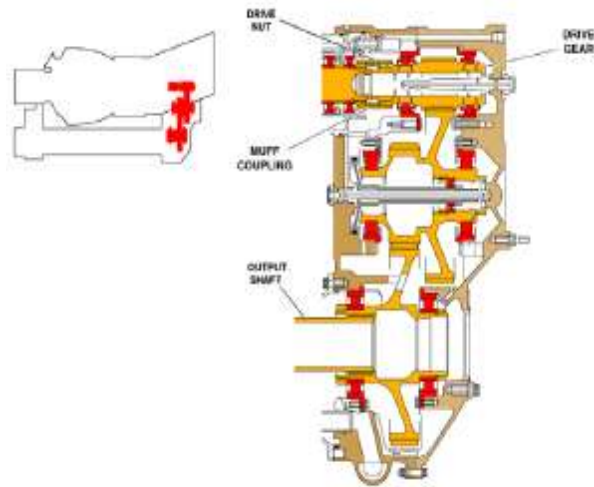


All the blades then came in contact with the shroud and lost approximately a quarter of their height. They also dug a groove in a section of the shroud corresponding to the lower position when the engine was upside-down. Such a level of damage indicates that the Power Turbine was rotating with power at the moment of the crash.



Module 5 (Reduction Gearbox)

The module 5 appeared externally intact with some soot deposits. It was separated from the Power Turbine module in order to reveal the splined drive nut on the drive gear's shaft. This nut transfers the torque delivered by the Power Turbine through the muff coupling to the reduction gearbox's gear train. Its position on the shaft is marked during the assembly process. Should the rotation of the reduction gearbox's output shaft be impeded during engine operation, then the torque applied by the Power Turbine on the nut will increase. During an accident, this may lead to an over-torque capable to rotate the nut on its shaft.



The drive nut's close examination revealed that the marks had moved by approximately 1.5mm. Consequently, the engine was delivering power at the time of impact.



Exhaust pipe

The exhaust pipe was bent and distorted and exhibited a “flattened” shape corresponding to an upside-down engine at the moment of the crash.



Dressing (pipes and harnesses)

Most pipes and harnesses appeared damaged, ruptured, burnt or crushed. The rear bearing assembly's breather pipe was sheared at its junction with the outer casing. The casing was significantly damaged in this area which corresponded with the top of the engine which hit the ground first as it fell upside down. No pipe was found with loose fixings and similarly, the harnesses' connectors were checked and found tightened.



Filters and clogging indicators

- Fuel filter and clogging indicator

The fuel filter was removed and the visual inspection showed that it was clean. The filter casing was totally dry. The clogging indicator cover was tarnished by soot and had to be opened to reveal that it had popped out. However, as the filter was clean, it probably popped out due to impact forces during the crash.



- Oil filter and clogging indicator

The oil filter was removed and the visual inspection showed that it was clean. The clogging indicator's cover had melted away but the indicator could still be checked: it did not pop out.



Magnetic Plugs

The magnetic plugs were checked and found clean or with non-significant amounts of particles.



Hydro-Mechanical Unit (HMU)

The fixing clamp was ruptured and the HMU was held only by its pipes. The metering needle actuator was separated from the main body and hung by its wires. The body of the LP pump was broken and the impeller was exposed. No fuel pumping nor control would be possible with such an extent of damage thus indicating that the damage occurred during the crash.



Valve Assembly

It was fixed to the engine with soil stuck around its upper part. This area could have been in contact with the ground when the engine was upside-down. Its support was slightly bent.



Bleed Valve

The main body was missing and only its fixing clamp and collar remained along with the actuator.

Ancillary Equipment

-EBCAU: this auxiliary device takes over the control of the engine fuel flow when the DECU is non-operational (in case of red “GOV” signal). The EBCAU was removed to expose the input drive shaft on the HMU. The key on the drive shaft was pointing North, thus indicating that it had not rotated and that the EBCAU was not operated during the flight.



- Free Wheel: the free wheel was rotating in the anti-clockwise direction thus indicating the normal sliding movement of the free wheel. It was locked in the clockwise direction which is normal in the drive direction.

- Front Output Drive Shaft: the screws of the flector were ruptured thus indicating a separation from the drive shaft to the Main Gearbox during the crash.



- Rear Output Drive: the rear drive flange was distorted and the flector was destroyed. By experience, this type of damage is found as consequence of a crash.



Engine Examination Summary

Large sections of the engine were covered with soot due to the post-crash fire. The engine exhibited significant damage to its casings, supports and equipment which was indicative of very high forces predominantly in the vertical direction with the engine upside-down. The engine would not be able to operate with such damage which can only be a consequence of the accident. The axial compressor's blades exhibited significant damage because of forced contacts with its distorted casing. Similarly, the Power Turbine blades exhibited significant damage because of the forced displacement of its casing. Such a level of damage indicates that the engine was rotating with power when the casings were damaged. This information is reinforced by the rotation of the MO5 drive nut on its shaft that indicates the presence of an over-torque at the time of the accident. The engine ingested metallic debris that splattered the HP turbine thus indicating that the combustion was established in the combustion chamber at the time of the crash. The HMU was significantly damaged to the point where no fuel pumping nor control can be possible. The LP fuel pump was destroyed and its impeller was

left exposed. No fuel could then enter the HMU after the crash and this explains the bone dry fuel filter bowl. Consequently, the engine flamed out within a few seconds after the crash.

1.16.2 Examination of VEMD & ECU Unit

Following components were sent to BEA, France (French Accident Investigation Agency) for data recovery, review and analysis.

1. VEMD (Vehicle and Engine Monitoring Display).
2. ECU (Engine Control Unit).

• VEMD

The computer was damaged. It was opened and the 2 main boards were visually inspected. One memory component was ripped off from its board.

The second memory component was still on its board. This board was dried for 48 hours at a temperature of 90°C. The memory component was unsoldered using an unsoldering machine under temperature monitoring.

Both memory components were cleaned, electrically characterized and read out using the BEA memory reader. The following binary files were generated:

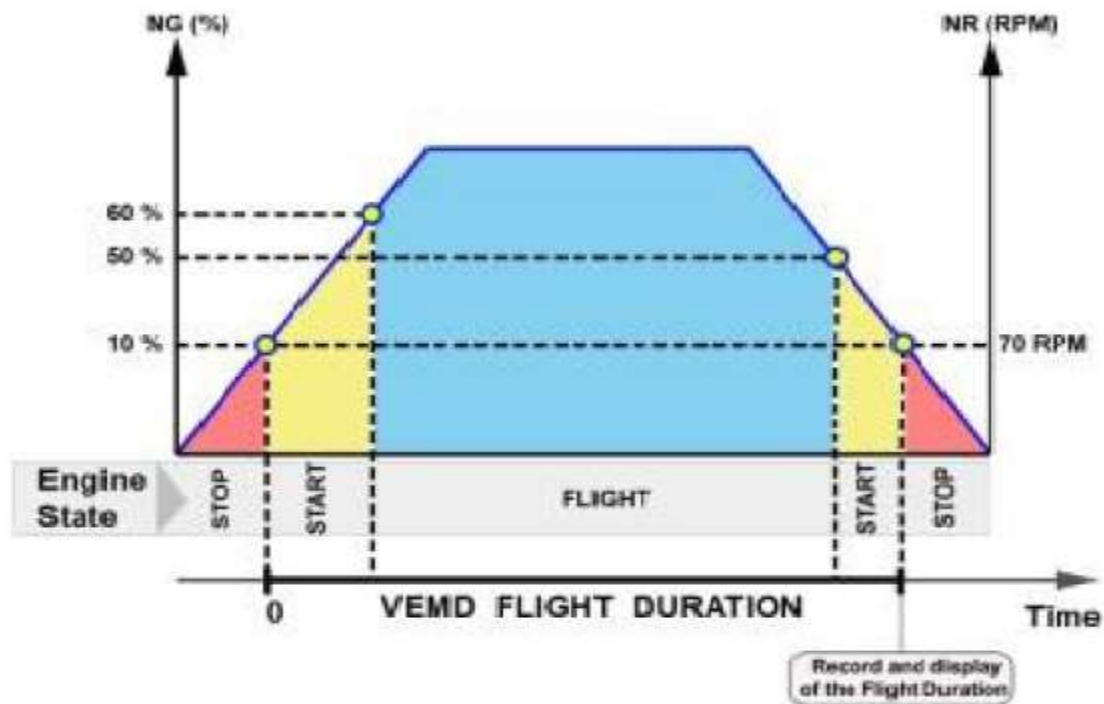
- VT-JKB_VEMD_7285_1-1.bin
- VT-JKB_VEMD_7285_2-1.bin

Results:

Data retrieved from both modules were consistent.

The data relative to the last recorded flight were associated to the flight numbered 5134 which lasted 1h 9min 34s. This flight was identified as the flight of the event.

The VEMD flight duration starts when the NG increases over 10% or when the NR increases over 70 RPM and ends when the NG decreases under 10% and the NR decreases under 70 RPM.



A recurrent failure is recorded at every flight in the failure report. The label associated to this failure is *SURV_UNDOFF_NR*. *SURV_UNDOFF_NR* failure is triggered if a low DC voltage is detected under specific offset conditions for 20 measurements on the NR input signal. This failure has no impact on the conductivity of the flight. No other failure was recorded for the flight numbered 5134.

Over limit in Torque was recorded with a duration of 2 seconds over 105%. The maximum recorded value was 108 %.

- **ECU(Engine Control Unit)**

The computer was externally burnt. The connectors were in good condition. The computer was opened. The four memory components were identified.

The memory components were unsoldered using an unsoldering machine under temperature monitoring. They were cleaned, electrically characterized and read out using the BEA memory reader. The following binary files were generated:

- *VT-JKB_EMCI01_X_U3.bin*

-*VT-JKB_EMCI01_X_U4.bin*

- VT-JKB_EMCI01_Y_U3.bin

- VT-JKB_EMCI01_Y_U4.bin

The manufacturer of the computer Triumph and Safran Helicopter Engines formerly known as Turbomeca were contacted to get the necessary documentation to decode raw data.

Results:

Channel A

Last power on number is 9870 and was identified as the flight of the event. The associated failures are summarized in Table 1.

Time	Label	Failure type
1 min 49 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	Operating system level
2 min 16 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
2 min 22 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
16 min 47 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
30 min 45 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
30 min 51 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
44 min 43 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
58 min 34 s	ARINC_HELICO, STATUS_A429_HELICO, TEST_PWM	
1 h 11 min 07 s	XPC	Applicative
	MESURE_P3A, STATUS_XR, STATUS_A429_HELICO, TEST_PWM, STATUS_V28AF	Operating system level

Table 1

XPC: This message indicates that the collective pitch measurement has reached an out-of-limit value (mini, maxi or gradient). The control system then triggers an amber “GOV” signal that indicates a “degraded” automatic operation of the control system which takes a back-up law for the collective pitch values.

In such a case, the flight manual instructs the pilot to adopt smooth manoeuvres and avoid sudden collective pitch changes. The control system remains in automatic mode.

Other discrepancy messages are at Operating system level and are not confirmed at Applicative level. They are thus without effect on engine control.

ARINC_HELICO, STATUS_A429_HELICO and **TEST_PWM** are recurrent failures in the failure report and are related to the ARINC 429 link. These failures don't affect the safety of the flight.

Status_XR: This message indicates the presence of a discrepancy on the reading of the resolver's sensor which indicates the position of the fuel metering needle.

Mesure_P3A: This message indicates a discrepancy with the P3 combustion chamber pressure measurement.

Status_V28AF: This message indicates that the operating software has detected a fall of the 28V aircraft power supply below 3V.

No context was associated to the failure occurring at 1 h 11 min 07 s.

Contexts are normally recorded upon the occurrence of confirmed discrepancies at Applicative level. The absence of contexts may be due to the total loss of power supply to the DECU as a consequence of the crash.

The *Operating system level* failure contexts were not decoded.

Channel B

Time	Label	Failure type
1 h 11 min 07 s	XPC	Applicative
	MESURE_T12A, MESURE_T12B, MESURE_P3A, STATUS_XR, STATUS_V28AF	Operating system level

Last power on number is 9867 and was identified as the flight of the event. Several failures were associated to this flight, see Table 2.

Table 2

XPC, Mesure_P3A, Status_XR and Status_V28AF: these discrepancies are explained in the previous paragraph.

Status_T12A & T12B: This message indicates that the helicopter T0 measurement reached an out of limit value (min, max or gradient). It is at Operating system level and is not confirmed by the Applicative software and thus is without effect on engine control.

No context was associated to the applicative failure occurring at 1 h 11 min 07 s.

As for channel A, the absence of contexts may be due to the total loss of power supply to the DECU as a consequence of the crash.

The Operating system level failure contexts were not decoded.

Conclusion:

A failure of the collective pitch anticipator potentiometer position (XPC) triggers when the measurement of the relative position of the potentiometer reaches its minimum (5 %) or maximum (95 %) thresholds or when its variation is above 350 % per second. Apart from a failure of the sensor or from the unusual displacement resulting from the consequences of an accident, these thresholds can't be mechanically reached because of the collective pitch system design.

According to BEA, Airbus Helicopters and Safran Helicopter Engines experience, the failure of collective pitch anticipator potentiometer is one of the first failures recorded in the sequence of failures following an impact with the ground.

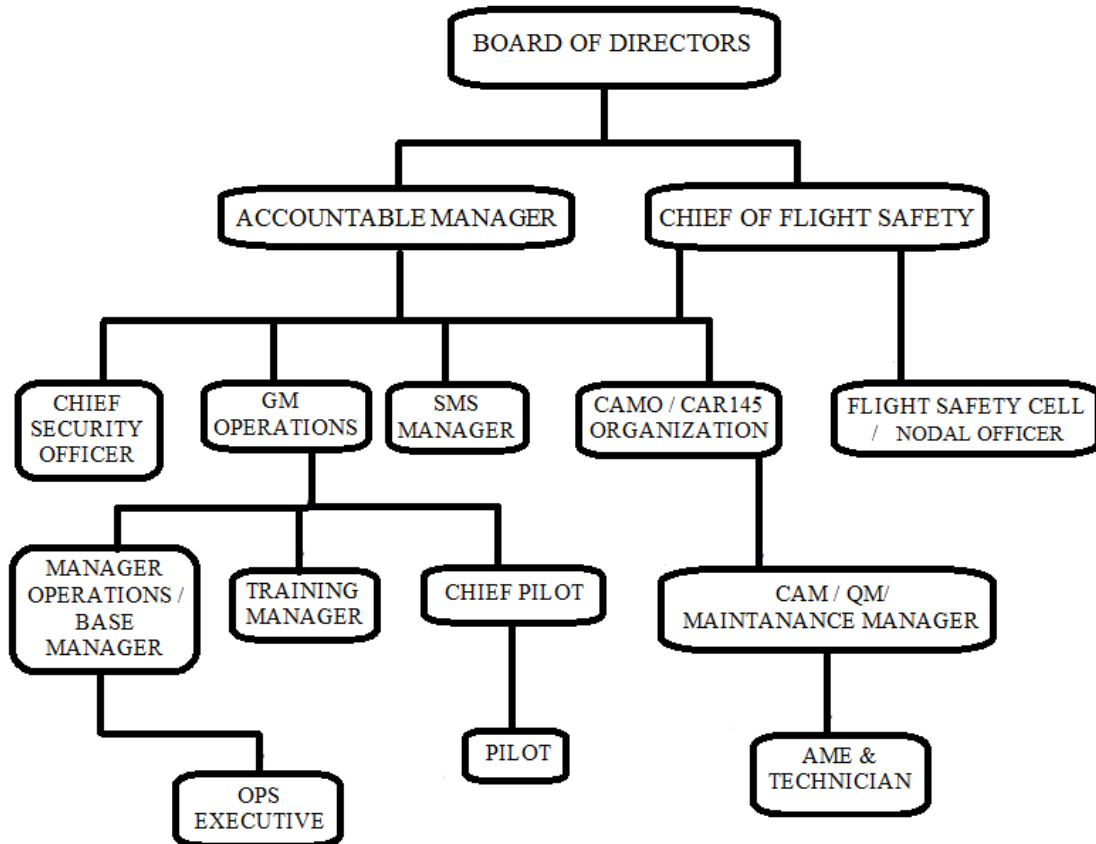
At 1 h 11 min 07 s, the computer recorded a high number of failures at the same time, among those the collective pitch anticipator potentiometer failure. All these recorded failures are most probably the consequence of the impact with the ground.

1.17. Organizational & Management Information:

M/s. Himalayan Heli Services Pvt. Ltd. (HHSPL), is a Non-scheduled Air Transport Operator, engaged in helicopter operation from its main base at IGI Airport, New Delhi. HHSPL was granted the Non Scheduled Operations Permit under AOP. NO. 1/2002 on 18 January 2002. HHSPL is marketing helicopter based tourism, such as Heli-trekking, Heli-safari, Heli-skiing Operations, External Load Operations and Pilgrimage Operations like

Shri Mata Vaishno Devi Shrine, Shri Amarnathji Yatra, Shri Kedarnathji Yatra and Shri Hemkund Sahibji Gurudwara etc. As per the AOP which was valid at the time of accident, the company had a fleet of 05 helicopters i.e. 04 Ecureuil AS 350 B3 and 01 Lama (Cheetah) SA 315 – B helicopter.

The Organisation Chart of the operator is given below.



The Director / Accountable Manager is assisted by the Chief Pilot, Chief Security Officer and the engineering divisions CAM, QM and MM. The maintenance of the helicopters are carried out in-house which is a DGCA approved CAMO & CAR–145 Maintenance Organization. The maintenance is carried out under its Quality Control.

The committee scrutinised the organisation documents which revealed that the operator did not have the valid approval for SMS and Operational Manual. The Flight Safety Manual had not been revised/reviewed after getting approval in December 2010.

1.18 Additional Information:

1.18.1 Risk Management

The organisation has made a flight safety manual and Chapter 13 of the manual describes the Organisational policy and procedures regarding “Risk Management”. Some of the salient procedures/policies are as follows:

- The basic safety process is accomplished by the following:
 - a) Identification of possible hazards.
 - b) Identification of causes leading to the manifestation of hazardous situation.
 - c) The corrective action / procedure is developed, evaluated for effective safe operation and implemented.
 - d) Disseminating of information regarding the hazard, cause, corrective action / procedure to all concerned periodic monitoring of the implementation of developed corrective action / procedures to maintain safe operating environment.
- One of the tasks of the Chief of Flight Safety is to identify hazards and ensure that the appropriate departmental head addresses the problems, the Chief of Flight Safety shall provide advice or recommendations on risk control actions. The decision on the acceptability and the method of handling the risk lies with the departmental head. If the risk remains unacceptable, then the flight or action should not be attempted.
- Risk management decision should be made at the highest practical level, delegating risk management to a subordinate may be inappropriate because the subordinate may not have sufficient information & skill required to make the risk decision. Nevertheless, the departmental head would still have to bear the responsibility of the decision, whether he agrees with it or not.
- Decision on whether or not to accept risk, should be based strictly on the magnitude of the risk and the benefits of accepting it. Personal convenience and Emotions should not enter the equation.
- **RISK PROFILE**

RISK Management is a systematic, explicit and comprehensive process for managing safety related risks and provides for planning and measuring the performance for achieving the desired goal. A risk management system is woven into the fabric of an organization. It defines the culture of its personnel at their work-place while discharging

their duties and responsibilities as per the laid down procedures. Main features of the risk management system are:

1. Philosophy:

- a) Recognising ever present possibility of threat to safety.
- b) Setting the organizational standards
- c) Ensuring that safety is everyone's responsibility.

2. Policy:

- a) Statements of Responsibility, authority and accountability without ambiguity.
- b) Development of organizational process and structures to incorporate safety goals into every aspect of the operation.
- c) Development of the skills and knowledge and necessary recurrent training to discharge the responsibilities.

3. Procedures:

- a) Distinct direction to all staff;
- b) Means for planning, Organizing Controlling.
- c) Means for monitoring and assessing safety status and processes through periodic reviews.

4. Practices:

- a) Following well designed, proven, effective & safe procedures;
- b) Avoiding the shortcuts, that deviates from SOP and endanger safety.
- c) Taking appropriate action when a safety concern is identified.
- d) Effective and prompt dissemination of information of identified areas of safety concerns.

In a well-managed organization every employee contributes to the safe operating environment at the work place. This can be achieved by the implementation and continuing support of coherent safety police which leads to well-designed procedures.

• **Decision Making**

- One of the tasks of the Chief of Flight Safety is to identify hazards and ensure that the appropriate Departmental Head addresses the problems. The Chief of Flight Safety shall provide advice or recommendation on Risk Control actions. The

decision on the acceptability and the method of handling the risk lies with the Departmental Head. If the risk remains unacceptable, then the flight or action should not be attempted.

- Risk management decisions should be made at the highest practical level / delegating risk management to a subordinate may be inappropriate because the subordinate may not have sufficient information & skill required to make the risk decision. Nevertheless, the Departmental Head would still have to bear the responsibility of the decision, whether he agrees with it or not.
- Decisions on whether or not to accept risk should be based strictly on the magnitude of the risk and the benefits of accepting it. Personal convenience and. Emotions should not enter the education.

1.18.2 - Reporting of Bird Activity

During the preliminary investigation it was stated by the pilots operating in Katra that sporadic bird activity along the designated flight route particularly between hotel and view point was observed between 3000 feet to 7000 feet AMSL, especially after 1100 hrs.

This aspect should have been brought to the notice of the operator, who in turn should have initiated necessary steps to revise the SOP and bring it to the notice of local civic authorities and the shrine board for long term solution. No steps seem to have been initiated for preventive and corrective action so that the flight safety is ensured/enhanced.

A similar kind of incident occurred 01 year later, in the same sector, on a helicopter operated by the same operator, wherein the bird hit the nose cone of the helicopter, causing rupture of skin and entered into the rudder pedal area of the cockpit. The helicopter landed back at Katra and was grounded for repairs.

It is apparent that, no appropriate importance was given to reporting the bird activity (potential hazards) by the flying crew and other personnel of the operators involved in the operations at Katra. Timely reporting and necessary action, on it, could possibly have precluded the accident.

1.18.3 Civil Aviation Requirement for simulator training

Civil Aviation Requirements Section 8 – Commercial Helicopter Operation Series H Part I, Sub Part 4 (B) – Pilot Qualifications gives requirement for simulator training for critical emergencies for operations. As per Para 5.3 of the said requirement:

Simulator Training – Critical Emergencies: At least 5 hours of mandatory practice of critical emergencies in simulator such as engine failure, system failure, tail rotor failure etc. which cannot be practiced in actual flying shall be carried out by a pilot on specific to type flight simulator once in two years. Training of autorotative landing is to be carried out close to the maximum permissible all up weight but in no case it should be less than 70% of the all up weight. In case a specific to type simulator is not available, 2:30 hours of flying training in simulated emergency handling is to be carried out in 2-3 dedicated sorties every two years on the type of helicopter. All Helicopter operators should include the same in their training manual/ procedures accordingly.

As per records submitted by the operator, the pilot had not undergone Simulator Refresher Training to practice critical emergencies on AS 350 B3 as per the above requirements.

1.18.4 Joint - Standard Operating Procedure for Helicopter operations from Katra to Sanjhichat Helipad.

A joint SOP has been made and approved by DGCA for helicopter operations carried out at Katra. The SOP has been prepared based on the requirements of CAR Section 8, Series ‘H’ part I and guidelines laid down vide Operations circular issued by DGCA from time to time. The committee scrutinised the Joint SOP and observed that there was no procedure mentioned in the SOP for regular review of the SOP and the changes to be incorporated in the SOP.

1.19 Useful and Effective Techniques:

Extensive and large number of photographs of the accident site, surrounding area & wreckage etc. were taken and analysed.

Investigating committee visited the accident site, place of dispatch and the surrounding areas.

In the absence of exact eyewitness(es) account(s) or statements of crew, a flight along the same route/path was carried out to establish / understand the cause of accident and probable conditions in the air, which lead to the mishap. The altitude, airspeed and direction, as

followed by the shuttling helicopters, and that of VT- JKB were followed, to obtain simulated flight condition.

During the flight following was also observed:

1. The force landing fields selected/marked in the Joint SOP, were found unsuitable for emergencies necessitating power off landings.
2. During the elapsed period between the time of selection of the force landing fields and the time of accident, due to constructions around the fields, Growth of trees and shrubs, around the force landing fields, has perforce necessitated steeper approaches for safe landings and effective usable landing space had reduced.
3. Katra Township having expanded considerably, area and population wise, the flight path followed by the helicopters is over/in close vicinity to built up/thickly populated areas, resulting in fewer force landing areas and noise pollution for the thickly populated area.

2. ANALYSIS:

2.1 Serviceability of Helicopter

The helicopter Ecureuil AS 350 B3 AS No. 2776 was manufactured by M/s Eurocopter, France in 2010. The helicopter was having valid Certificate of Registration (C of R). It holds valid Indian certificate of Airworthiness (C of A) under category Normal, Sub-Division Passenger and valid till lifetime. Airworthiness Review Certificate was issued on 09.10.2015 and was valid at the time of accident. The helicopter had done 4169 airframe hrs and 7288:47 engine hrs till the day of accident. There was no snag reported by the pilot before the accident flight and as per records there was no recurring defect either.

The VEMD & ECU data analysis report concluded that all the recorded failures are most probably the consequence of the impact with the ground.

The engine tear down analysis report clearly indicated that, at the time of accident, the engine was running and producing necessary power. The engine stopped running after the impact.

The helicopter was refuelled and after refuelling 09 shuttles were carried out before the accident flight. Therefore the availability of fuel on board was approximately 140 litres. As

the helicopter was completely burnt, it was not possible to verify the quantity of fuel on board. However the intensity of fire indicates there was sufficient quantity of fuel on board.

In view of the above, it is considered that the serviceability of the helicopter is not a factor to the accident.

2.2 Weather

The weather at Katra during the time of accident was reported to be fine with clear sky, fine visibility, winds 225°/04 kts and Temperature 29°C.

In view of the above it is inferred that weather is not a contributory factor to the accident.

2.3 Pilot Factor

The PIC was having a valid license & medical. On 23/11/2015, the PIC successfully flew 09 shuttles of approximately 10 to 12 minutes each from Katra helipad to Sanjichat helipad. While carrying out the tenth shuttle from Katra helipad, after about 2 minutes after take-off, the helicopter was observed from the ground, to turn back and descend. It subsequently struck electric cables short of a small open space, topple over and impacted the ground upside down.

A dead and partially burnt vulture was found inside/beneath the wreckage, indicating a bird strike in flight. This most probably resulted in the pilot to discontinue the flight to Sanjichat and turn/head towards the small open space, in an endeavour to carry out a force landing.

The vulture having been found inside/below the wreckage indicates to it having struck the wind shield of the helicopter and entering the cabin after shattering it. One wing of the vulture was found approximately 80 meters away from the main wreckage.

The pilot having multiple endorsements had sufficient experience (Civil & Air Force), would have developed sufficient expertise, wherein after the bird strike and regaining control of the helicopter, would have opted to return to Katra helipad where all assistance was available for rescue, handling of the passengers, assessment of damage and repair of the helicopter.

The very fact that the helicopter headed/was flown to a small open space (not a designated forced landing field as per the SOP) and crashed after striking cables, implies that the situation with the pilot/helicopter was of a very grave nature.

2.4 Circumstances Leading to Accident.

Helicopter VT-JKB was climbing to Sanjichat at approximately 4500 feet AMSL (1500 feet AGL). Bird activity had been witnessed in the circuit area between the railway station and Sanjichat. After crossing the railway station a bird strike was experienced.

All the factors, evidences, especially statements of other pilots, eyewitness and technical analysis, were considered by the Committee and no conclusion could be drawn for the actual cause of the accident. Therefore, circumstantial situations and various possible scenarios were considered to determine the cause/factors leading to the accident and are discussed below:

Scenario A

Had the vulture struck the helicopter below the cabin, it most probably would have fallen away outside and not entered into the cabin, from where it was subsequently found. In this scenario the pilot would have been able to safely fly back to Katra helipad, since most probably minor damages would have occurred, not seriously affecting the handling of the helicopter.

Scenario B

The vulture strikes the helicopter from above the Rotor Disc and strikes the Main Rotors. In this case most of the body would have been smashed and fallen away outside the helicopter cabin. This would have resulted possibly in some damage to the Main Rotor blade/ blades, resulting in vibrations in the helicopter. However, lower power/speed settings would have reduced the severity of the vibrations, resulting in easier handling of the flying controls and the pilot would have been able to land back at Katra helipad, which was approximately 2 to 2 ½ minutes flying time away.

The above two scenarios are very improbable as the pilot would be in full control of the helicopter. Also, as the carcass of the dead vulture was found in one piece (not scattered).

Scenario C

The pilot spots bird/birds and takes avoiding action by initiating a descending turn, away from the bird/birds.

- i. The pilot initiates a descending turn to the left. However during the turn bird strikes on the co-pilot side, shattering of the wind shield and hitting the front passengers. The passengers panic, instinctively duck and move away from the bird. The inner passenger inadvertently falls on/ pushes down on the collective and/or grabs the pilot, momentarily resulting in a temporary loss of controls of the helicopter. During the process of regaining controls the pilot heads for the first open space/ area spotted. The pilot in this difficult situation fails to spot electric cables around the selected / intended landing area, strikes the cables, resulting in the helicopter impacting the ground upside down. Subsequently a fire breaks out and engulfs the helicopter, completely burning the cabin area before the fire is extinguished by the police and the fire tenders that had rushed to the accident site.
- ii. The pilot initiates a descending turn to the right, however during the turn a bird struck the helicopter on the pilot's side, shattering the wind shield and probably hitting the pilot. The focus of pilot momentarily shifts from the helicopter controls, to clean the remains of the birds. The pilot spots an open space and heads towards it. Due to the difficult situation, electric cables close to and around the open space are not noticed/spotted by the pilot. The helicopter strikes the cables, causing the helicopter to impact the ground upside down. Subsequently a fire breaks out and the cabin area is completely burnt before the fire is extinguished by the fire tenders and police, who rush to the crash site.

The above scenarios are improbable as the pilot after gaining the control of the helicopter would have opted to land back at Katra helipad, which was close by. It would also have been possible to land at the open space i.e. crash site with a reasonably safe outcome.

Scenario D

A bird strikes the wind shield, breaks it and enters the cockpit such that the pilot is probably hit, severely injured, unconscious and incapacitated. The helicopter floats uncontrolled in the air, strikes electric cables and crash lands upside down. In such a case, an uncontrolled

helicopter could have crashed at any place, between the railway station and hotel. The very fact that it crashed near the open space, proves/hints towards a controlled approach for landing. Therefore the complete incapacitation of the pilot is improbable.

Scenario E

A bird strikes the wind shield, breaks it and enters the cockpit, probably strikes the pilot such that the pilot is stunned, vision is impaired and momentarily loses consciousness (partially incapacitated). By the time the pilot recovers consciousness and regains control of the helicopter, it had descended and was close to the open space and pilot chose to continue for landing in the spotted open space. The pilot did not notice/spot the electric cables and the helicopter struck them, toppled & impacted the ground upside down and caught fire.

In view of the above it is considered that 'Scenario E' could be the most probable circumstance leading to the accident.

3. CONCLUSION :

3.1 Findings :

1. The Certificate of Airworthiness, Certificate of Registration & Certificate of flight release of the helicopter was valid on the date of accident.
2. The helicopter and engine were maintained as per CAME, approved by Office of DDG (NR), DGCA, New Delhi.
3. The pilot was having a valid license, valid medical and was qualified on type.
4. The total experience of pilot on AS 350 B3 helicopter was 2367 hours.
5. Prior to the accident day, the pilot last flew in Katra on 12.11.2015.
6. After the break, the pilot returned to Katra on 23.11.2015 and was straight away rostered for the flight on the same day.
7. There was bird activity observed by the pilots in that area, on the day of accident.
8. On the day of accident, prior to the accident flight a total of 24 shuttles were carried out by the helicopter. All these shuttles were reported to be uneventful.
9. There was no snag reported prior to the accident flight.
10. The helicopter took-off from Katra helipad for Sanjhi Chat with 06 passengers on board.
11. The pilot gave a take-off call on RT.

12. While en-route to Sanjhi Chhat and climbing a vulture hit the helicopter, broke the windshield and entered the cockpit.
13. The pilot then made efforts to land immediately at the vacant area spotted ahead and headed for it.
14. The electric cables around the vacant area were not spotted by the pilot.
15. The helicopter got entangled in electric cables, which caused it to turn upside down and crash.
16. The helicopter immediately caught fire and the helicopter less the tail boom was completely burnt.
17. All the occupants on board the helicopter received fatal injury.
18. Weather at the time of accident was fine.
19. A dead partially burnt vulture was found underneath/inside the cabin area of the wreckage.
20. One of the wings of the vulture was recovered from a distance of 80 meters from the main wreckage.
21. The operator did not have a valid approval for SMS, Ops manual. The Flight Safety Manual had not been revised after getting approval in December 2010.
22. The pilot log book was not available during inquiry. The necessary details/data were certified by the operator and forwarded for the inquiry.
23. The ELT failed to trigger and transmit due to impact.
24. Periodic simulator training as per the relevant CAR requirements was not done by the pilot.

3.2 Probable Cause of the accident :

Due to bird strike, the pilot was stunned, vision impaired and heads for landing towards the open space, could not notice the electric cables, the helicopter hits the cables, topples and landed upside down catching fire.

4. Safety Recommendations :

1. The SOP in vogue should be regularly reviewed by the operators and all changes to be recorded (including NIL). Responsibility for periodical reviewing of the SOP should be fixed and included for non-scheduled operations.
2. The Safety Audit of, alternate landing sites and forced landing sites (specifically identified for emergencies of power loss), as mentioned in the SOP, to verify, for continued suitability and availability, to be carried out from time to time by the DGCA during inspections and audits.
3. The affectivity of the SOP and its compliance by the Operators may be checked by DGCA.
4. The pilot after a defined break, of flying in the sector, must fly familiarisation /refresher sorties with a qualified pilot before commencing independent operations.
5. Training of pilots regarding handling of critical Emergencies and practices must be carried out on simulator as per the requirements of relevant CAR.
6. The crash site was very close to thickly populated areas and it is sheer providence that no other damage occurred on the ground. Therefore, the Operator/Shrine Board may consider alternate routing away from built up area. This will also reduce the noise pollution.
7. In view of intensive daily flying, round the year and handling of a large number of passengers, the Shrine board may consider constructing a heliport equipped with fire-fighting /crash facilities, ambulance, passenger handling, security, refuelling, maintenance, traffic control weather forecasting and other required facilities.
8. The operator should review the mechanism of reporting of bird activity & potential hazards by the pilots, is done in timely manner and to ensure that the necessary safety measures are enforced immediately. The mechanism should be continuously monitored to ensure that all potential hazards are accordingly reported and addressed.
9. Front seat passenger to be briefed, in addition to the common briefing, for bird look out and bringing it to the notice of the pilot and the same to be included in the SOP.



(Capt. JPS Kniggar)
Operational Member

(Yash Pall)
Chairman

K. Ramachandran
(K. Ramachandran)
Air Safety Officer (E), AAIB
Member

Date: 27.10.2017

Place: New Delhi