INVESTIGATION REPORT ON ACCIDENT TO AGUSTA AW 119 MK II HELICOPTER VT- NRK ON 10-06-2017 AT BADRINATH JI HELIPAD, UTTARAKHAND.

GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU

Foreword

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an accident/ incident shall be the prevention of accidents/ incidents and not to apportion blame or liability.

This report has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of engine. 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 Kestrel Aviation Pvt. Ltd. Agusta AW119 MK II Helicopter VT-NRK Near Badrinathji Helipad on 10.06.2017			
1.	Helicopter	Type	Agusta AW 119
		Nationality	Indian
		Registration	VT-NRK
2.	Owner		M/s Kestrel Aviation Pvt. Ltd.
3.	Operator		M/s Kestrel Aviation Pvt. Ltd.
4.	Pilot – in –Command (Pilot Flying)		CPL (H) Holder
	Extent of injuries		Minor
	Co-pilot (Pilot Monitoring)		CPL (H) Holder
	Extent of injuries		Minor
5.	Date & Time of accident		10-06-2017, 0200UTC.
6.	Place of accident		150 m south of Badrinath ji Helipad, Uttarakhand
7.	Co-ordinates of accident Site		30° 45’ 02” N, 079° 29’ 50” E
8.	Last point of Departure		Badrinath ji Helipad, Uttarakhand
9.	Intended landing place		Haridwar helipad, Uttarakhand
10.	No. of Passengers on board		06 (Including 01 AME)
	Extent of injuries		Fatal Injury to AME on board/ No injuries to other passengers
11.	Type of Operation		Charter flight (NSOP Operations)
12.	Phase of Operation		Take-off
13.	Type of accident		Helicopter crashed on down sloping terrain just after take-off.

1.0 FACTUAL INFORMATION

1.1 History of Flight

On 10th June 2017, Agusta AW119 MKII helicopter met with an accident while operating Badrinathji – Haridwar sector which was the last leg of Chaar Dhaam Yatra (Haridwar- Kharsali – Harsil – Guptkashi – Badrinathji – Haridwar). These sectors were flown by a Pilot in Command (PF) and a Co-pilot (PM) and had 6 passengers on board including an Aircraft Maintenance Engineer (AME).

As per the procedures being followed in the organisation for carrying out Chaar Dhaam, on the day previous to the day of operation, the chief pilot of the organisation used to inform the crew about the flight program for the next day. In the present case Chaar Dhaam Yatra was to be carried out on 8th and 9th of June 2017.

As per plan the helicopter took-off for its first leg of Chaar Dhaam from Hardiwar on 8th of June at 0633 hours IST and landed at Kharsali at 0708 hours IST. The crew then took-off from Kharsali at 1303 hours IST and landed at Harsil at 1338 hours IST. The crew and passengers carried out a planned night halt at Harsil.

On next day i.e. 09.06.2017 the helicopter took-off from Harsil at 0703 hours IST and landed at Guptkashi at 0738 hours IST. The crew underwent pre-flight medical check which included Breath Analyser test at Guptkashi. After carrying out refuelling, the helicopter took-off from Guptkashi and landed at Badrinathji. All these flights were uneventful and as per the cockpit crew there was no abnormality observed on the helicopter during all these sectors. The helicopter as per the plan was supposed to bring back the passengers to Haridwar on 9th June 2017 itself, but the weather at Badrinathji started deteriorating while the crew was waiting for the passengers. It was therefore decided by the crew not to carry out onward flight on 9th June 2017.

On 10th June 2017 the crew carried out pre-flight checks and no abnormality was observed. After all the passengers boarded the helicopter the PF started engine and all the parameters were observed to be normal. Hover check was carried out before take-off. The weather at that time was fine, with calm winds and outside air temperature around 10^{o}C.

As the helicopter left the helipad and came out of the ground effect, the PF observed slight sink, which he tried to arrest by raising the collective (increasing the power). As per the PF, the helicopter continued to sink further, despite collective being raised. When the helicopter was moving forward along with sinking, as per the PF, he noticed electric cables in front. In order to avoid the same he gave a slight bank towards right. He has further stated that though he could avoid the cables but the helicopter impacted the sloping ground (Terrain sloping downwards to the left of the final position of helicopter). The helicopter impacted the ground in a little right bank attitude and its right skid touched the sloping terrain first with main & tail rotor blades simultaneously hitting the terrain. The helicopter tilted towards left and came to halt in a left bank attitude.

The AME who was occupying the left window seat (with face towards rear) received fatal injuries during the accident. It was reported that he had vacated the helicopter before it has finally settled. (LH Emergency Window plexi frame upper red strap was found still in position with the lower seals pushed out). He was hit by the main rotor blades when the rotor was still turning at high speed.

The PF had shut off the fuel valve and switched off the battery. All the passengers evacuated the helicopter from left emergency window. Both the cockpit crew then came out of the helicopter from their respective side. There was no injury reported to any of the passengers. The crew escaped with minor injuries. The helicopter was substantially damaged during the accident. There was no fire.

1.2 Injuries to Persons

Injuries	**Crew**	**Passengers**	**Others**
Fatal	NIL	01 (AME)	NIL
Serious	NIL	NIL	NIL
Minor	02	NIL	NIL
None		05	NIL

1.3 Damage to Helicopter

The fuselage was found tilted on the LH side, with approximately 50 degrees of bank with vertical. Damage details are as follows (Damage photographs are attached as Annexure I):

1. Both the skids were damaged and severed from the structure due heavy impact with ground.
2. All the four main rotor blades were found damaged due impact with ground.
3. The tail rotor blades were found severed from tip upto mid span.
4. The lower vertical fin/ tail rotor guard was found severed from the tail boom structure.
5. Two of the Main Gear Box support beams were broken and dislodged by the static overload at the impact.
6. The MGB was dislodged and tilted towards the LH side
7. Left horizontal stabilizer was found damaged.
8. Windshield on both sides was found broken.
9. Anti-collision light below tail boom was found sheared off.
10. A portion of lower surface of the tail boom skin was found punctured and severely damaged.
11. VHF antenna was found damaged.

1.4 Other Damages

Trees around the accident site and in the path of the flight were found cut from the top by the main rotor blades of the helicopter just prior to and during the accident.

1.5 Personnel Information

1.5.1 Pilot- in- Command (Pilot Flying)

AGE	51 years
License	CPL(H)
Valid upto	28/05/2022
Category	Helicopter
Class	Single Engine Land
Endorsements as PIC on	R44, R66, AW 119 MK-II

Date of Joining Company	24th March 2017
Date of Endorsement as PIC on MK-II	28th April 2017
Instrument Rating	Nil
Date of RTR issue	24th May 2011
Date of FRTOL issue	29th May 2012
Date of last Med. Exam	1st March 2017
Date of last Route Check	23rd May 2017
Date of last Proficiency Check	19th April 2017
English language Proficiency	Proficient
Date of last CRM	8th April 2017
Date of last Monsoon training	4th April 2017
Date of last refresher	31st March 2017
Total flying experience	2897:05 Hrs
Total Experience on type	58:30 Hrs
Total Experience as PIC on type	29:30 Hrs
Last flown on type	9th June 2017
Total flying experience during last 01 Year	58:30 Hrs
Total flying experience during last 180 days	58:30 Hrs
Total flying experience during last 90 days	58:30 Hrs
Total flying experience during last 30 days	25:40 Hrs
Total flying experience during last 07 Days	04:40 Hrs
Total flying experience during last 24 Hours	01:05 Hrs
Rest period before the flight	16 Hrs

The PF had served with IAF for 22 years where he operated Mi-17 & Chetak helicopters and had flown for about 2550 hours. While serving for IAF he operated in North East Sector on Mi-17 helicopters and had about 700 hours of hill flying. In 2014 he joined a private organisation and flew Robinson R66 helicopters as Pilot in Command. In 2015 he obtained fixed wing license with Instrument Rating in USA. He has flown PA-28/200, PA140 and Cessna 152 aircraft.

He joined the present operator in March 2017. After joining he was immediately subjected to conversion training on AW119 MKII helicopter which

also included 30 hours of theoretical course for initial rating carried out at Leonardo Helicopters, Italy. On 19.04.2017 he was subjected to Skill test by day and night of 00:45 hours each under the supervision of DGCA Type rated examiner. He got AW119 MKII endorsement on 28.04.2017 and started flying the type of helicopter.

After few hours of flying covering a weeks time after endorsement, the flight crew was deputed for carrying out Chaar Dhaam flying. The PF was released for hill flying after 11 hours of hill flying with Instructor/Examiner. The area flown while attaining the hill experience was the Chaar Dhaam routes. Though the PF was released on 23rd May 2017, he continued to fly as co-pilot (PM) for about 22 hours till 6th of June 2017.

1.5.2 Co-pilot (Pilot Monitoring)

AGE	35 years
License	CPL(H)
Date of Issue	16/01/2017
Valid upto	15/01/2022
Category	Helicopter
Class	Single Engine Land
Endorsements as PIC on	Chetak, AW-119 MK-II
Date of Joining Company	24th March 2017
Date of Endorsement as PIC on Bell 206	28th April 2017
Instrument Rating	Nil
Date of RTR Issue	22nd June 2016
Date of FRTOL issue	26th Oct 2016
Date of last Med. Exam	14th Oct 2016
Date of last Route Check	19th May 2017
Date of last Proficiency Check	19th April 2017
English language Proficiency	Proficient
Date of last CRM	9th April 2017
Date of last Monsoon training	4th April 2017
Date of last Refresher	31st March 2017
Total flying experience	1902:20 Hrs

Total Experience on type	61:00 Hrs
Total Experience as PIC on type	49:05 Hrs
Last flown on type	9th June 2017
Total flying experience during last 01 Year	109:15 Hrs
Total flying experience during last 180 days	61:00 Hrs
Total flying experience during last 90 days	61:00 Hrs
Total flying experience during last 30 days	52:00 Hrs
Total flying experience during last 07 Days	08:25 Hrs
Total flying experience during last 24 Hours	01:15 Hrs
Rest period before the flight	16 Hrs

The PM served IAF for 10 years where she operated Chetak, Cheetah, Mi-8 & Mi-17 helicopters since 2006 and got released from IAF in the year 2016. She had about 1841 hours of flying experience with IAF. While serving for IAF she operated in North East Sector also.

She joined the present operator in March 2017. After joining she was immediately subjected to conversion training on AW119 MKII helicopter which included 30 hours of theoretical course for initial rating carried out at Leonardo Helicopters, Italy. On 19.04.2017 she was subjected to Skill test by day & night of 00:45 hours each under the supervision of DGCA Type rated examiner. She got AW119 MKII endorsement on 28.04.2017 and started flying the type of helicopter.

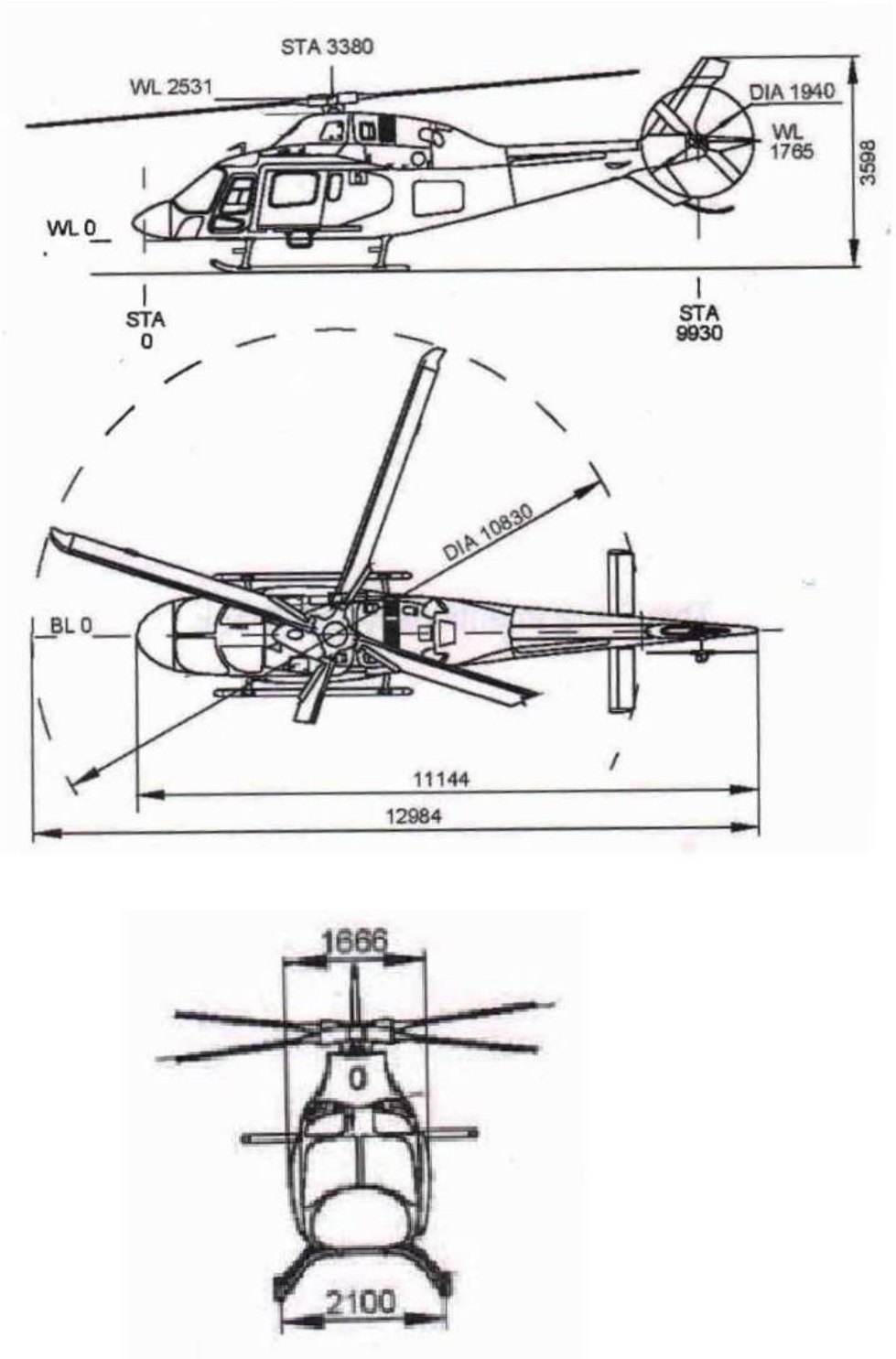
After endorsement, she flew for a week's time in Mumbai and was then deputed for carrying out Chaar Dhaam flying. The PM was released on 19th May 2017 for hill flying as PF after 15:30 hours of hill flying with Instructor/ Examiner and she was flying as PF since then. The area flown while attaining the hill experience was the Chaar Dhaam routes.

1.6 Helicopter Information

1.6.1 Helicopter - AW 119 MK-II

Agusta AW 119 MK-II helicopter is a single engine helicopter certified in transport category with sub category Passenger, for day operation under VFR. The maximum operating altitude is 15000 feet density altitude and maximum take-off weight is 2850Kgs.

The cabin includes the crew compartment (cockpit) and the passenger compartment. Seating is provided for the pilot (right side) and a passenger (or co-pilot) in the cockpit, and up to six passengers in the rear compartment.



3 view diagram of AW 119 MKII (Dimensions in millimetres)

The aft section accommodates the fuel tanks, the electrical and electronic equipment compartment and the baggage compartment. The landing gear skid is secured to the undersides of the cabin and rear sections.

The tail boom is bolted to the forward fuselage and supports the tail rotor and the relevant drive system. The tail boom includes the stabilizers, the upper and lower vertical fins, the tail skid and the tail cone.

The helicopter has four bladed fully articulated main rotor, two bladed tail rotor and a fixed landing gear skid.

The following replacements/ installations were carried out as per the Supplement Type Certificates (STC), approved by FAA, prior to the delivery:

- Replacement of the basic Cross tubes with new parts, designed and manufactured by Dart Aerospace Ltd (STC SR03504NY)
- Replacement of the basic Skids with new parts, designed and manufactured by Dart Aerospace Ltd (STC SR02024SE)
- Installation of an Air Conditioning kit, designed and manufactured by Air Comm Corporation (STC SR00463DE)
- Replacement of the basic Integrated Display System with the Garmin G1000H PFD/MFD display system (STC SR03280NY)

1.6.2 Power Plant

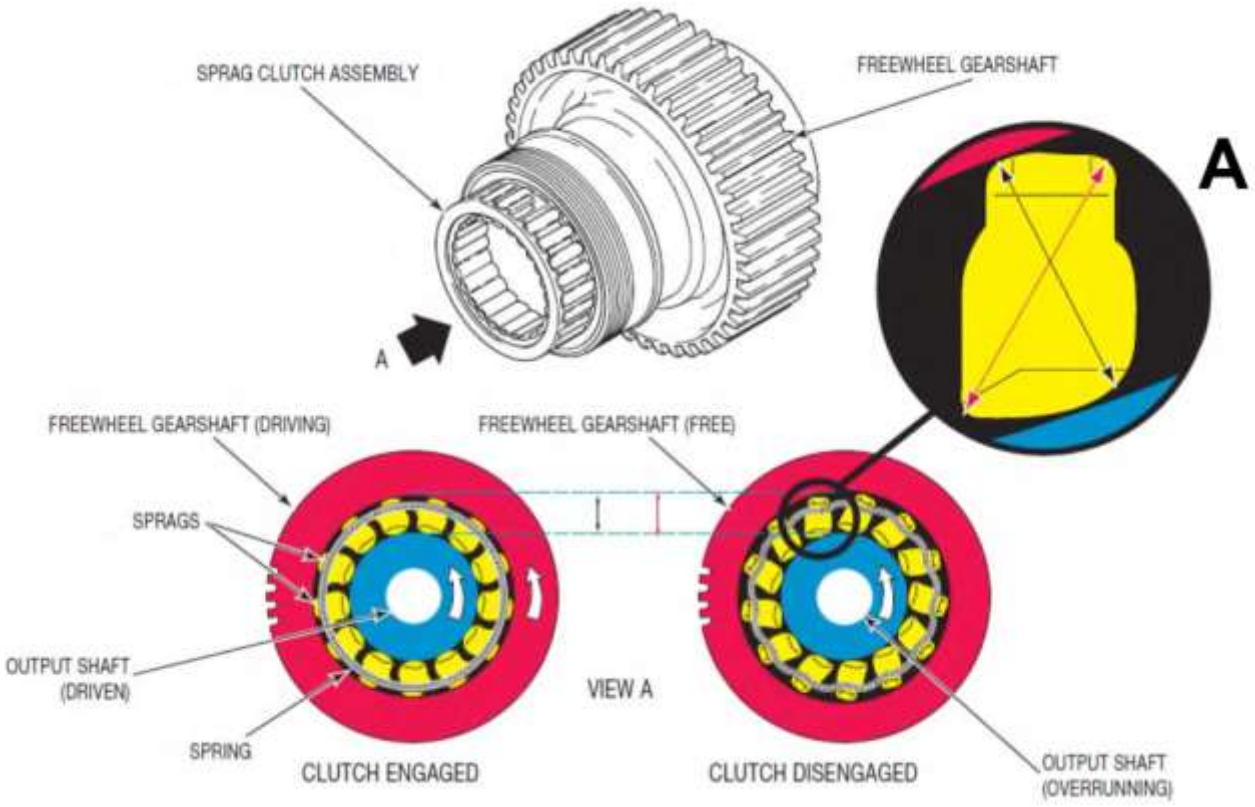
The AW119 MKII helicopter is powered by a single Pratt & Whitney PT6B-37A turbo-shaft engine.

The engine is a free turbine turbo-shaft propulsion engine incorporating a compressor consisting of 3 axial stages and 1 centrifugal impeller driven by a single-stage compressor turbine. Power is managed by an electronic-hydro pneumatic control system.

The mode select torque motor is used to select the mode of governing. It is actuated by an EEC/ MEC mode select switch located in the cockpit. In case of emergency the EEC is by-passed and mechanical N_f governing starts.

The manual override system enables the pilot to manually modulate fuel flow directly with the PLA twist grip on the collective lever.

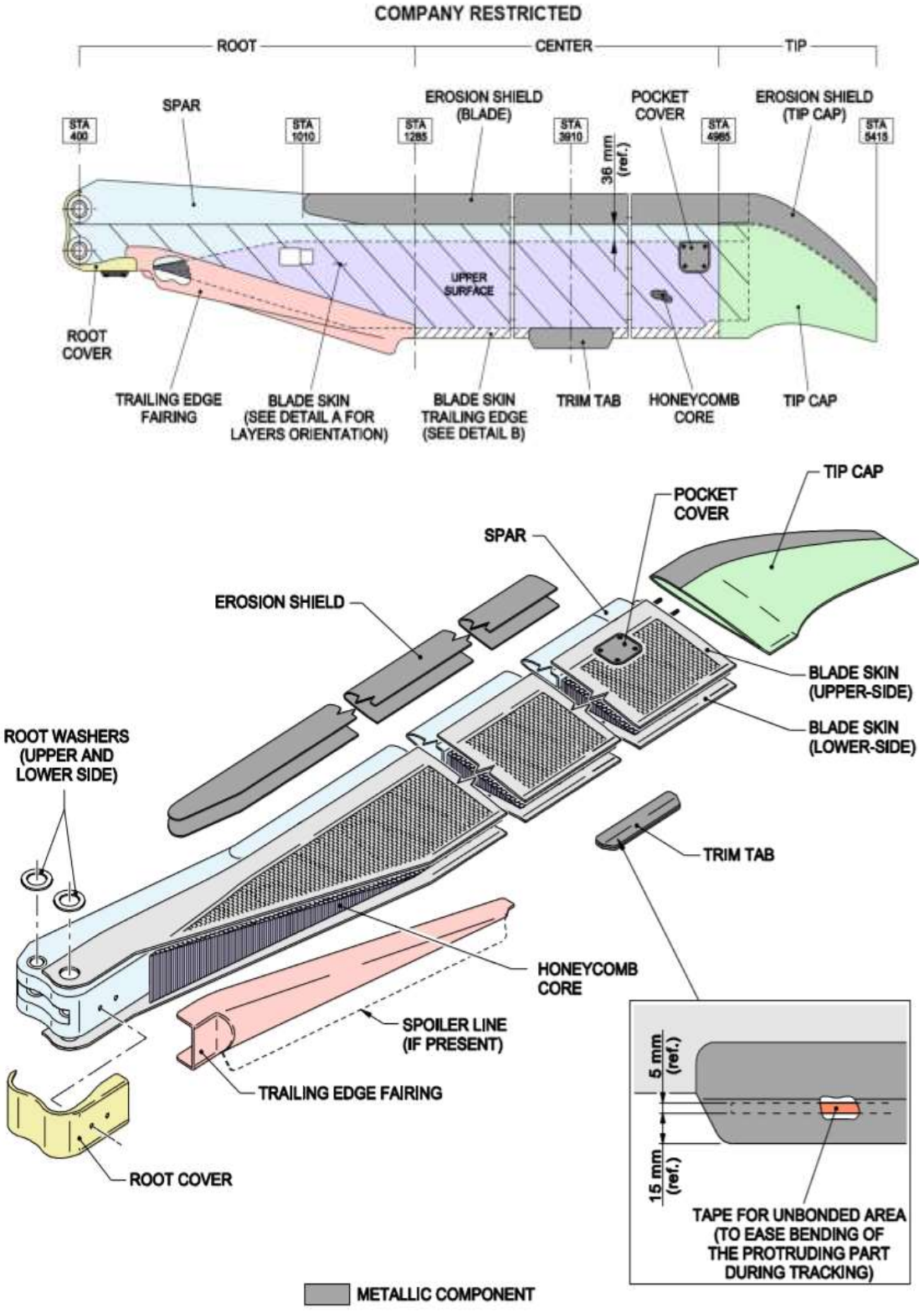
1.6.3 Sprag Clutch



The clutch arrangement shown above in the PT6B-37A reduction gearbox is a sprag clutch type which allows movement in only one direction. The clutch assembly is made up of a number of sprags which have a figure 8 shape. The vertical height of the sprag (depicted by the red arrow in the circle "A") is higher than the gap between the inside diameter and outer race (depicted by the black arrow in the circle "A"). The engaged position places the sprags at a slight angle so that when the engine freewheel gearshaft is rotating it will lock the sprags between the outer and inner races due to the interference fit which will drive the output shaft. If the output shaft attempts to drive the engine (freewheel gear shaft) then the sprags will be relieved and the output shaft will rotate without the engine.

1.6.4 The Helicopter (Specific Information)

a)	Helicopter Model	:	AW 119 MK II
b)	Helicopter Serial. No.	:	14840



Overview of the design of the AW109/119 family Main Rotor Blades

c)	Year of Manufacturer	:	2015
d)	C of R	:	4624, dated 29th Oct 2015
e)	C of A	:	6734, dated 13th Nov 2015
f)	C of A Validity	:	Lifetime validity
g)	A R C issued on	:	16th Nov 2016
h)	ARC valid up to	:	16th Nov 2017
i)	Aeromobile License No.	:	A-055/WRLO–15
j)	Valid up to	:	30th Oct 2020
k)	Engine Type	:	PT 6B – 37A
l)	Engine Sl. No.	:	PCE – PU 0251
m)	Helicopter Empty Weight	:	1831 Kgs
n)	Maximum Take-off weight	:	2850 Kgs
o)	Date of helicopter weighment	:	23rd July 2015
p)	Total Airframe Hours	:	431:20 Hours
q)	Total Engine Hours	:	431:20 hours

The helicopter and its engine were being maintained under continuous maintenance as per maintenance program consisting of calendar period based maintenance and Flying Hours / Cycles based maintenance. The last major inspection i.e. 400 hrs scheduled inspection was carried out at 354:15 airframe/engine hours on 24th April 2017. Subsequently all lower inspections, after last flight inspection and pre-flight checks were carried out as and when due before the accident. The last inspection carried out on helicopter was 25 hours inspection at 421:05 airframe/engine hours on 2nd June 2017.

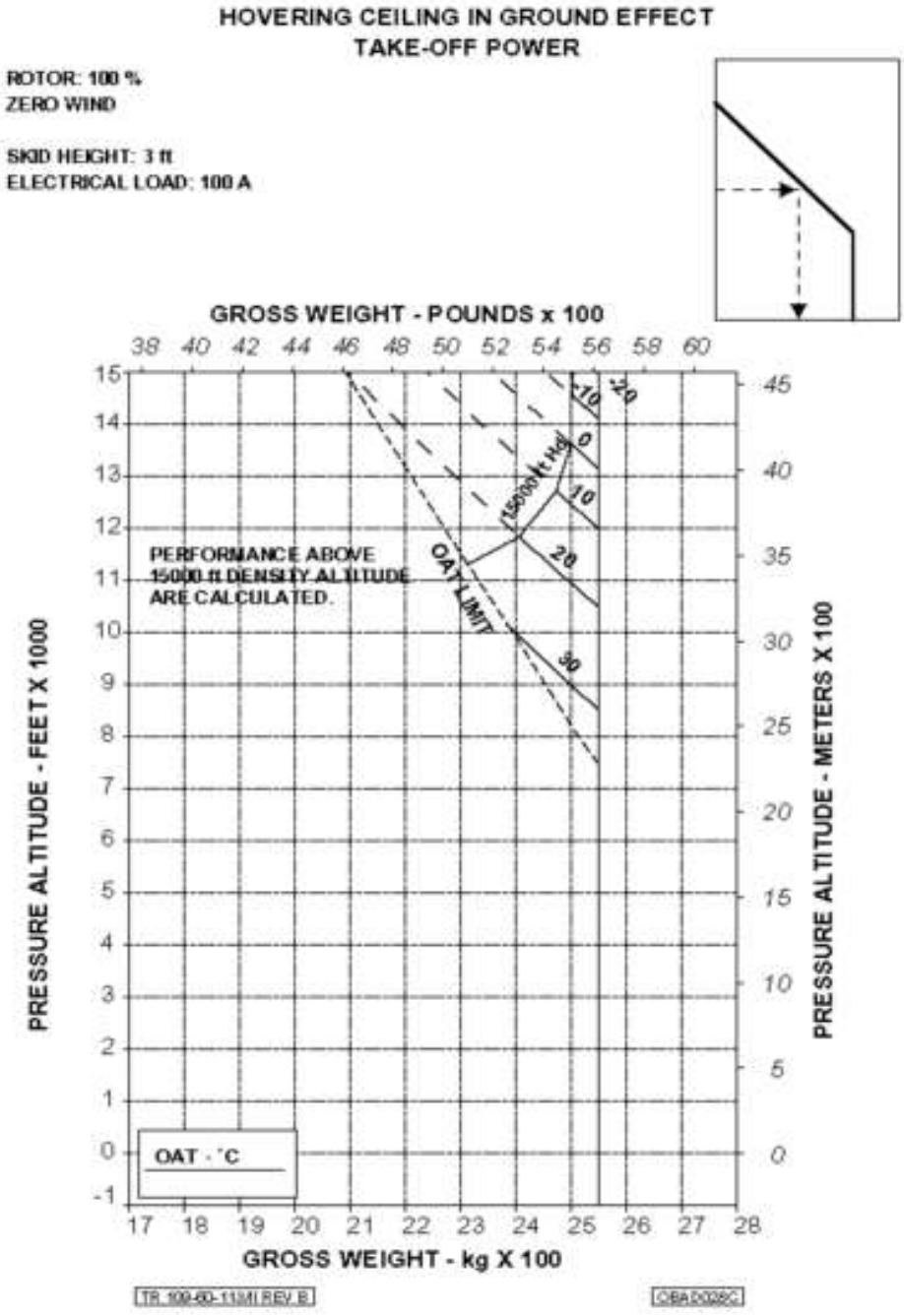
All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modification on this helicopter and its engine have been complied with as & when due.

1.6.5 Helicopter performance

The subject helicopter type is certified to fly upto a maximum operating altitude of 15000 feet density altitude and maximum take-off weight is 2850 Kgs. The Rotorcraft Flight Manual (RFM) of the helicopter provides various charts for calculating hover Ceiling In-Ground-Effect (IGE) and Out of Ground

Effect (OGE) both for Take-off Power (TOP) and Maximum Continuous Power (MCP). The maximum gross take-off weights can be calculated as a function of pressure altitude and Outside Air Temperature (OAT) for 100% N_R and zero winds.

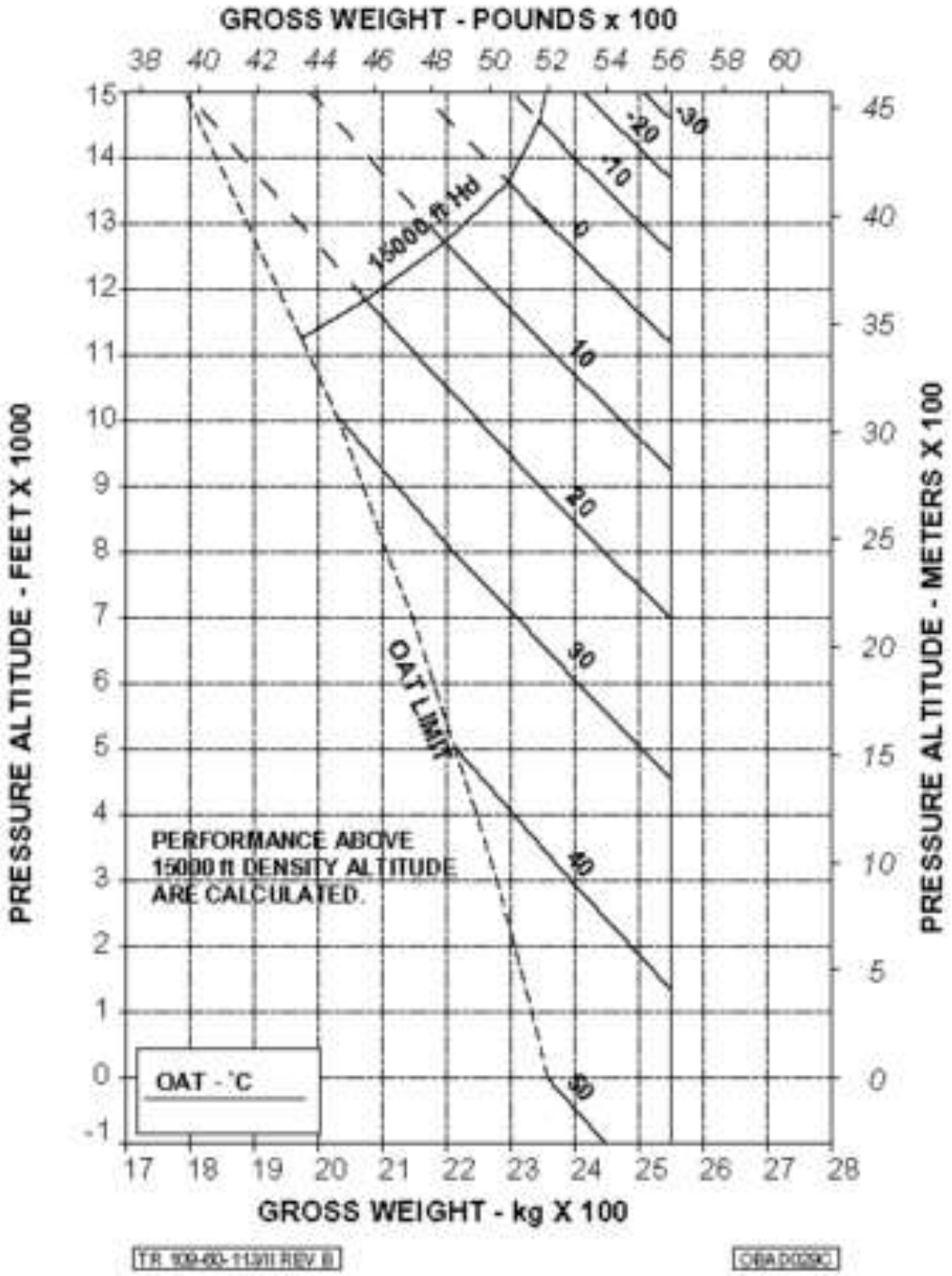
These charts provide the maximum gross weight for hovering IGE (3 ft skid height AGL) and OGE (at least 60 ft skid height AGL) both for take-off power rating and for maximum continuous power rating and are given below:.



HOVERING CEILING IN GROUND EFFECT
MAXIMUM CONTINUOUS POWER

ROTOR: 100 %
ZERO WIND

SKID HEIGHT: 3 ft
ELECTRICAL LOAD: 100 A



TR 109-60-1131I REV B

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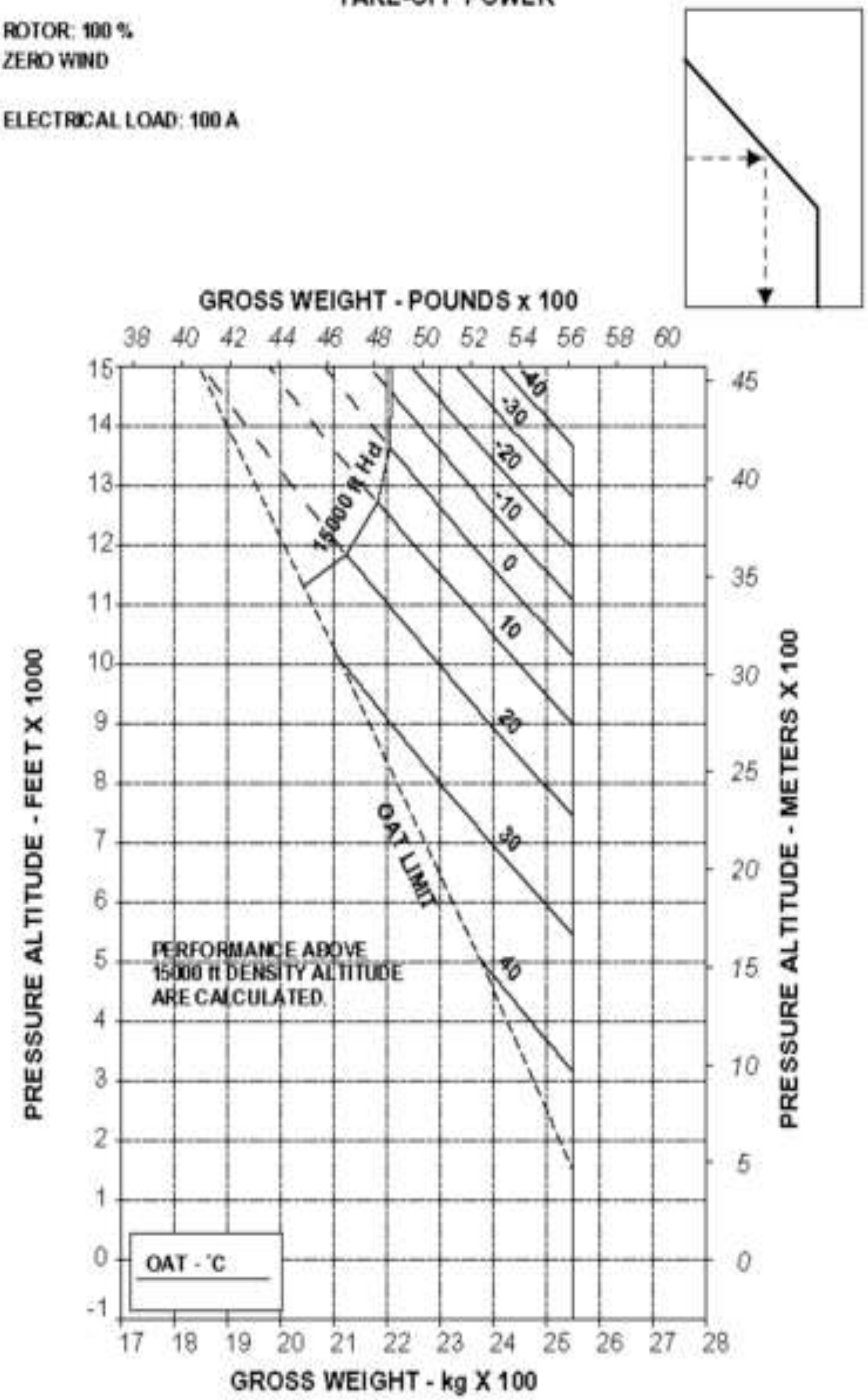
HOVERING CEILING OUT OF GROUND EFFECT
TAKE-OFF POWER

ROTOR: 100 %
ZERO WIND

ELECTRICAL LOAD: 100 A



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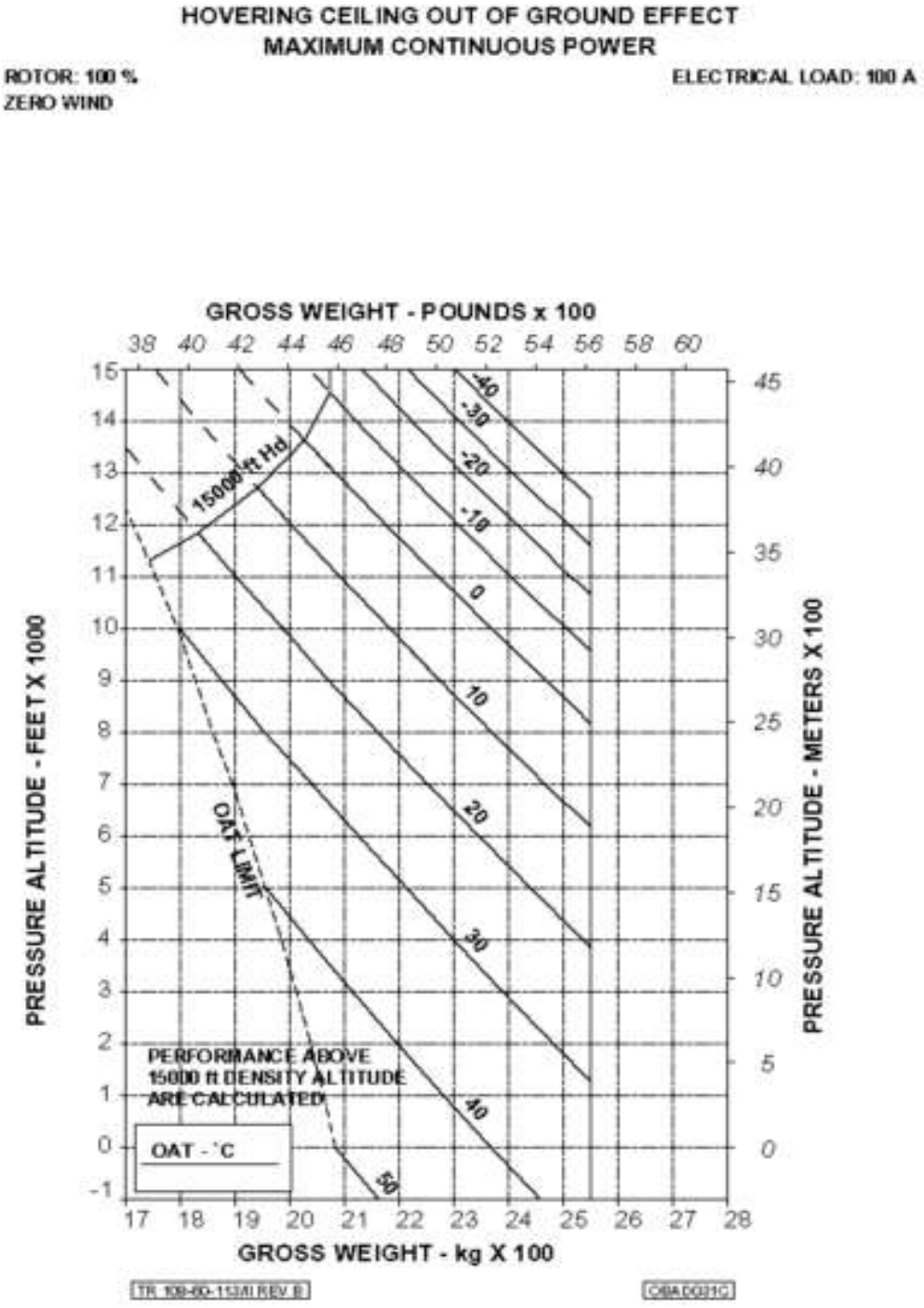


- The above Hovering In Ground Effect (HIGE) / Hovering Out of Ground Effect (HOGE) performance charts are calculated using a maximum load on the electrical generator of 100A (corresponding to 50% of the maximum rated load). As per the Manufacturers, in case the electrical load exceeds 100A (e.g. if the Battery is being recharged by the on-board generator after being partially depleted) a further pro-rata performance reduction between 20 and 50 kgs has to be considered.

- In case the Air Conditioning kit is active during take-off, a further reduction of 24.5 kg (54lbs) as per the Air Conditioner manufacturer's documentation has to be considered when estimating the helicopter maximum HIGE/HOGE ceiling using the approved RFM charts.

1.6.6 Weight & Balance of the helicopter

The load & trim sheets for all the sectors (Haridwar - Kharsali – Harsil – Guptkashi – Badrinath ji - Haridwar) were prepared before the first leg of the series of flights. Normally there used to be the same passengers for all the legs of Chaar Dhaam Yatra. The baggage load for all the sectors was taken as 10 Kgs.

The computation carried out for the flight was as follows:

COMPUTATION

A) Max Take Off Wt : **2850** Kgs
B) Datum : **4.475** Mts Forward of Aft Jacking Pts
C) Empty Weight CG: **3.618** Mts Aft of Datum

S/N	Item description	Weight(Kgs)	Arm(Mts)	Moment (Kg Mts)
1	Basic Empty Wt(W/O dual cont)	1827	3.618	6610.086
2	Pilot	85	1.585	134.725
3	Copilot/Passenger	85	1.585	134.725
4	Passenger(Front LH)	75	2.455	184.125
5	Passenger(Front Centre)	75	2.455	184.125
6	Passenger(Front RH)	75	2.455	184.125
7	Passenger(Rear LH)	75	3.2	240
8	Passenger(Rear Centre)	75	3.2	240
9	Passenger(Rear RH)	75	3.2	240
10	Baggage Compartment-Max 150 Kg	10	5.56	55.6
11	Fuel-Max Usable - 476 Kgs	220	3.571	785.62
12	Dual Controls if fitted	4	1.6	6.4
	Total	**2681**		**8999.531**

CG for the Flight=Total moment/Total Weight= $\frac{8999.531}{2681}$ = **3.35678142** Mts

As per the load & Trim sheet prepared for the accident flight the All up Weight of the helicopter at the time of take-off was 2681 Kgs wherein standard weights of passengers and Flight Crew members have been taken as per the CAR on the subject. Centre of Gravity was within limits.

1.7 Meteorological Information

There is no meteorological office at Badrinath ji. Meteorological briefing is to be taken from IMD online/ telephone from Jolly Grant Airport, Dehradun/ Air Force Station, Saraswa with simultaneous attention paid to current satellite pictures and prevailing weather. Prior to flight, actual weather conditions of the region and the helipads shall be ascertained and assessed by crew. As per the pilot the weather at the time of take-off was fine with clear sky, winds calm and temperature about 10^{o}C.

1.8 Aids to Navigation

The helicopter is only VFR cleared and is equipped with ADF, VOR, DME, ATC Transponder and GPS. Helicopter was flying using Jeppesen Map, Ground references and GPS.

1.9 Communication

The helipad is an uncontrolled helipad. As such at the time of take-off, helicopter was not in contact with any ATC unit. After the accident the PF informed the company on telephone regarding accident.

1.10 Aerodrome Information

Badrinath ji Helipad with hard top surface (concrete) is one of the temporary helipads used for helicopter operations for ferrying passengers mostly pilgrims in the area. Before start of operations in the month of April 2017, DGCA has inspected the helipad and gave observations for compliance to the State Government prior to start of Chaar Dhaam operations. On receipt of compliance, DGCA inspected the helipad again and cleared it for operations. It fulfilled all the requirements of a temporary helipad such as markings and signage visible from the air.

The co-ordinates of the helipad are 30^{o} 45' 03.13" N, 79^{o} 29' 49.86" E, with elevation as 10,200 feet. The helipad can accommodate about 04 helicopters at a time. The helipad is surrounded by hills and has only one direction for landing and take-off. The valley starts immediately after the helipad.

1.11 Flight Recorders

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

1.12 Wreckage & Impact Information

The wreckage was self-contained. Following are the main observations from the wreckage. Additional photographs of wreckage are appended as Annexure II.

- The helicopter sank just after take-off during which it hit the ground/ terrain in nose up and a slight left bank condition. The helicopter first impacted a hard rock imbedded to the ground with the rear portion of right skid hitting the ground which got severed from the main structure. A significant impact mark was found on the rear part of the Fuselage, just below the Baggage Compartment due impact with a sharp rock.

- Broken pieces of the main rotor blades were found scattered around the main wreckage. A piece was found at a distance of about 80 meters from the main wreckage. The roots of the blades were found attached to the hub. Marks of main rotor blades impacting the ground were observed.

- The lower vertical fin/ tail rotor guard impacted the ground and was found separated from tail boom. The tail rotor blades were sheared off up to mid span due impact with hard rocks and trees.

- As the ground had a downward slope towards left of the helicopter, the helicopter rolled towards left (though remained almost at the same point), resulting in left skid impacting the ground. The cross tubes of the skids were found tilted approximately 180 degrees upwards.

- The helicopter finally came to halt in a left bank attitude resting on the ground on its broken left skid and fuselage with the support of rocks & bunch of small trees. The final position of helicopter was approximately 150 m south of the take-off point and directly below the electric cables (power line) passing in the area.

- Two of the Main Gear Box support beams were broken and dislodged. The MGB got dislodged and tilted towards the LH side. The Cockpit airframe was severely damaged, with the Pilot and Co-pilot door mounts sheared in different positions.
- All the rotating controls (blade pitch links, rotating scissors and fixed scissors) were continuous and connected. All the Cockpit switches and circuit breakers were found in positions as is after an emergency shutdown.

1.13 Medical & Pathological Information

The crew were subjected to Medical check including Breath Analyser Test on 09.06.2017 at Guptkashi and no abnormality was observed. Breath Analyser test was negative (not under the influence of alcohol). After the accident the crew were again subjected to Breath Analyser Test and were found not under the influence of alcohol.

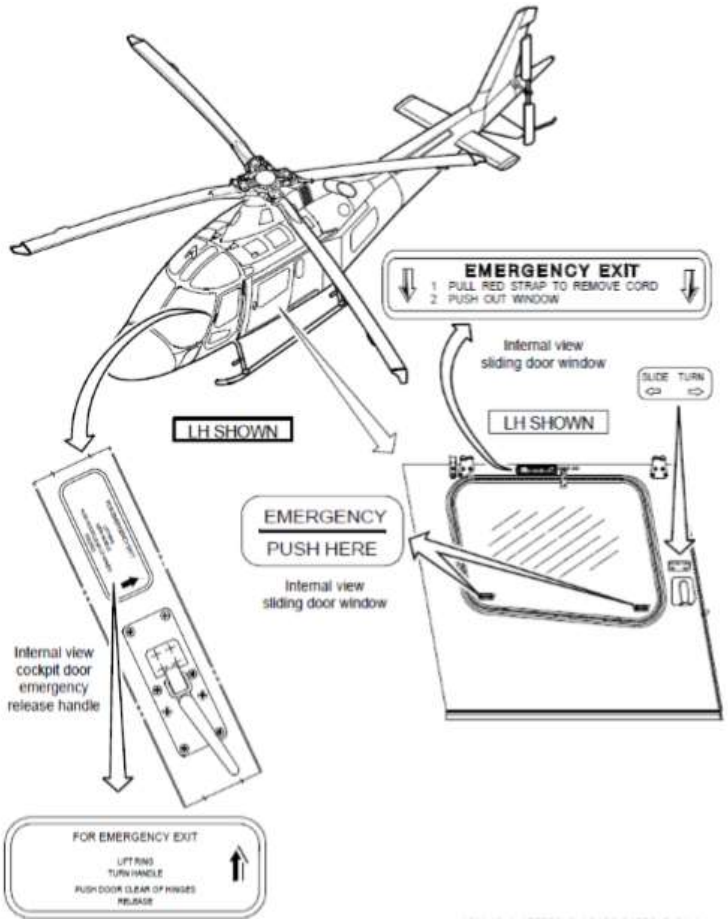
1.14 Fire

There was no pre or post impact fire.

1.15 Survival Aspects

The AME who was one of the occupants of the helicopter probably after seeing that the helicopter is sinking came out of the helicopter when the

main rotor was still turning at high speed. He was hit by the Main Rotor Blades and received fatal injuries.



Location and markings of AW119MKII Emergency Release Mechanisms on LH side

All other passengers left the helicopter with nil injuries from the same exit when the main rotor blades had stopped after the impact. The emergency strap of the window (beading) was found at its place intact. The Cockpit airframe was severely damaged, with the Pilot and Co-pilot door mounts sheared (broken) at different positions.

The accident was otherwise survivable.

1.16 Test & Research

As the accident had occurred in the hills, it was decided to bring the helicopter down and carry out external examination of the damages and engine in detail. The fuel and 2 litres of oil were drained and the helicopter straightened upright. Tail boom was removed to ease the transportation and the accident helicopter was shifted to Mumbai.

External visual assessment of the engine was carried out at Mumbai in association with the technical personnel from the operator and P&W.

- All the tubing found intact without any deformations/ dents/ disconnections.
- No damage observed on flexible hoses.
- Fuel filter bowl was found to be without any external damages/ signs of leaks.
- Locking wire of the fuel filter bowl found to be intact.
- All electrical connections were found to be ok with the connectors installed properly.
- None of the wires/ harness found to be damaged or cut.
- Oil filler cap was found to be installed properly.
- Fuel Heater was found to be satisfactory without any signs of fuel/oil leakages.
- Starter-Generator installation was found to be satisfactory with all its connections intact. FCU installation & its connections were found ok.
- The condition of engine inlet screen was found to be satisfactory without any damages/ deformations.
- No signs of oil accumulation/ wetness found in engine bay or under the engine.

- No abnormality observed with fuel nozzle.
- Inlet Screen removed, found compressor free to rotate without any binding.

Boroscopic Inspection of second stage of axial compressor and combustion chamber was satisfactory. Condition of all the blades of compressor & power turbine was found satisfactory as seen from behind. Power Turbine could be rotated freely. It was possible to rotate the First Stage of Axial compressor.

Output shaft of the reduction gear box could be rotated freely and was still able to rotate Main rotor shaft through transmission. The main chip detector was clean.

Though no abnormality was observed during the preliminary examination, in order to ensure beyond any doubt the proper functioning of involved engine, it was sent to manufacturer's facility for further examination. The engine examination was performed at Pratt and Whitney Canada St-Hubert, Canada, facilities in presence of investigator from Leonardo Helicopters and a detailed report was received. Following are the summary of findings and conclusions:

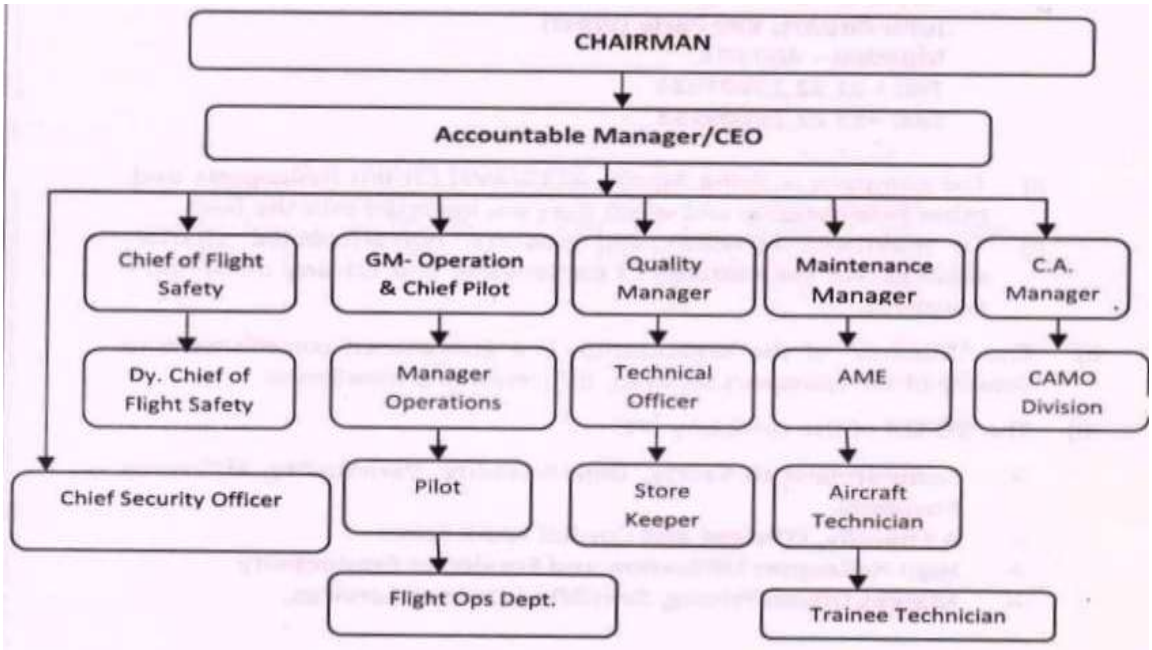
"The engine showed almost no signs of impact damage with the exception of deformation seen on the fuel manual over-ride linkages. There was no evidence of pre-impact anomalies found on the compressor. The compressor turbine blades contained a reddish environmental discoloration though no signs of damage or rubbing. The centrifugal compressor showed signs of rubbing with the centrifugal impeller shroud. There was evidence of the power turbine blades rubbing with the power turbine shroud. The #2 bearing housing showed extensive corrosion, however this does not have an impact on flight operations. Wet oil was found in the Power Turbine area which likely occurred during transport. The sprag clutch was found seized, in a position indicating that at the time of seizure the engine was driving the helicopter rotor. The Engine Electronic Control (EEC) was downloaded and an Nr event and N_f critical fault observed indicating a loss of signal or rotation of the main rotor which is driven by the power turbine (N_f). This is consistent with the findings of the sprag clutch seizure due to a main rotor stoppage. There

was no damage in either the reduction gearbox or accessory gearbox besides normal wear. The Power Turbine Governor, Electronic Governing Unit (EGU), flow divider, Fuel Control Unit (FCU), and fuel pump were all tested and there were no findings that would have impacted normal flight operations.

The seized position of the sprag clutch indicates that the engine was driving the helicopter rotor at the time of impact. The engine displayed no indication of any pre-impact anomalies or distress that would have precluded normal engine operation prior to impact.

1.17 Organizational & Management Information

The operator is having a Non- Scheduled Operating Permit (NSOP) No. 14/2008 and is valid upto 08-05-2019. The following is the organisational chart of the organisation as given in various manuals.



Organizational Chart of the operator

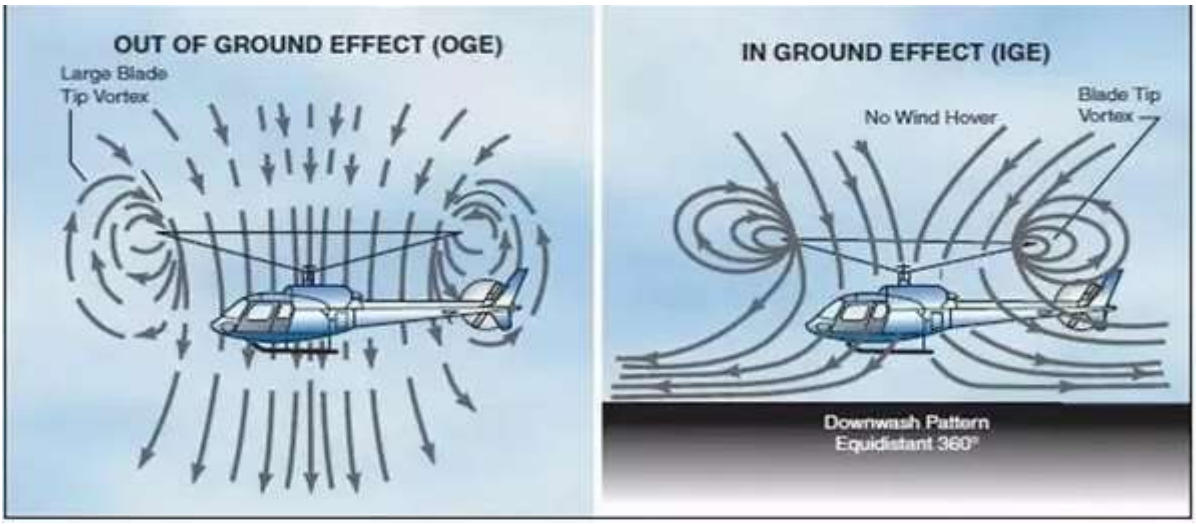
The main base of the operator is at Mumbai. Around a month and half, the operator for the first time started the helicopter services from Haridwar to various destinations in Uttrakhand for conveyance of pilgrims to Badrinathji, Kedarnathji and other areas. These operations were carried out as and when

the requirement arose. The Standard Operating Procedure for carrying out these operations was approved by DGCA. On the date of accident the operator had in-house CAR 145 maintenance approval.

1.18 Additional Information:

1.18.1 In and Out of Ground Effect (IGE & OGE)

The movement of the main rotor blades through the air creates relative wind i.e. the air flows relative to the main rotor blades. Relative wind moves in a parallel but opposite direction to movement of the blade. There are two components of wind passing a rotor blade, a horizontal component caused by the blades turning plus movement of the helicopter through the air and vertical component caused by the air being forced down through the rotor blades plus any movement of the air relative to the blades caused by the helicopter climbing or descending.



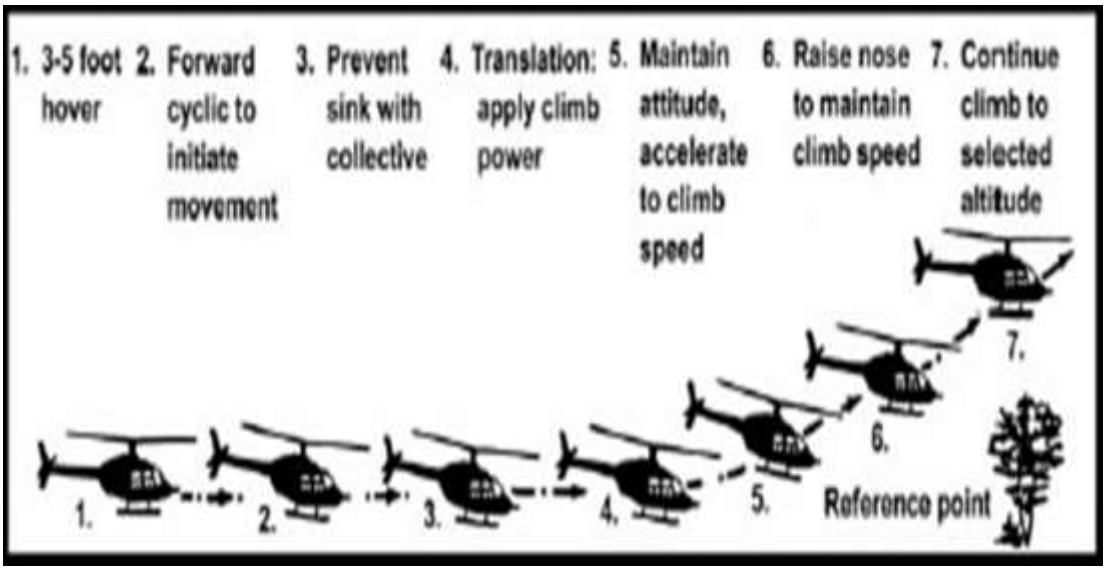
When the helicopter is near the ground, this vertical component of air from the main rotor impacts with a hard surface (the ground), and give a useful reaction to the helicopter in the form of more lift force. What happens is the air impacts with the ground and causes a small build-up of air pressure in the region below the rotor disk. The helicopter is then "floating" on a cushion of air. This means that less power is required to maintain a constant altitude hover and the helicopter is operating In Ground Effect (IGE). The height at which the helicopter is treated IGE depends on the type of helicopter, the slope and nature of the ground, and any prevailing winds.

The air circulation patterns change when hovering is without ground effect (OGE).

The helicopter designer/ manufacturer normally provides the HIGE/ HOGE charts for calculating the maximum all up weight vis-a-vis ceiling for take-off purposes. These charts for AW-119-MKII are discussed in para 1.6.5 above.

1.18.2 From hover to climb

At hover all the vertical component of Lift/ Thrust (total rotor lift) is utilised to counter the weight of the helicopter. For take-off, the rotor disc is tilted forward to get some forward thrust, which is a component of total rotor Lift. As the rotor disc is tilted forward, there is a reduction in vertical component of thrust, which is balancing the weight, and a rearward drag is generated, to counter these, total rotor thrust required is more; Pilot has to increase the collective, thus increasing the engine output power. The limits of power available i.e. the Take-off Power rating is given in the Flight Manual of that particular helicopter type.

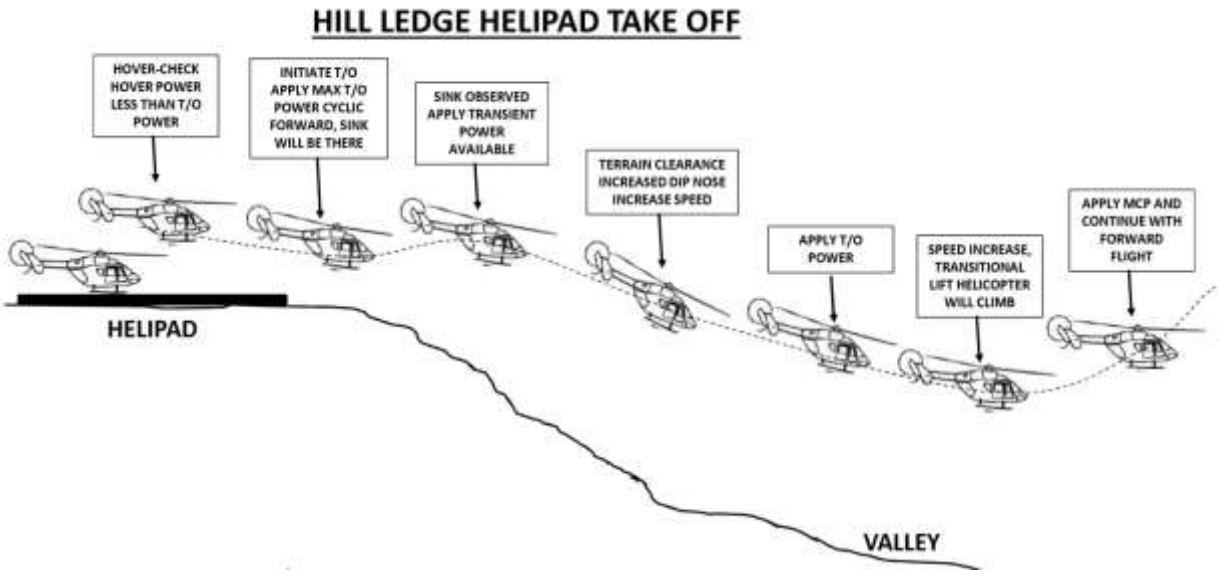


In the figure above, Take Off power is applied between Point 3 and Point 4 (Translational). If at any point the helicopter starts losing altitude, the sink can be controlled by using the transient limits of Power, though for a very short period of time which is given in terms of N1/ N2/ ITT or TOT for engine. (These powers are not to be used intentionally). The limits are given

in the RFM of the helicopter. The other limitation is the torque to be used for transmission as per RFM. There after (beyond Point 4) Climb power which is same as Take-off power is used. After takeoff is completed, pilot uses Max Continuous (MCP) or lesser power for level flight.

1.18.3 Take-off from ledge helipad

After take off from a ledge helipad (having descending valley in Take-off path) with a valley ahead and terrain going down, normally the pilot carry out a normal take off using max take off power and initiate forward flight. If any sink is observed which can be due to wind or losing ground effect, (which will happen the moment helicopter clears of the helipad ledge) apply transient power available to arrest the sink. By doing so, the helicopter should stop sinking and an upward/ climb inertia may set in.



From here onwards since the terrain clearance between helicopters is increasing due to valley going down, one has to dip the nose of the helicopter down in a controlled manner to increase the forward velocity to 25 Kts to 40 Kts to get full effect of transitional lift and then reduce power in a controlled manner. The above manoeuvre has to be executed looking outside the helicopter (cannot depend on instrument indications, as they have lag and manoeuvre is precise), only a glance inside is required to ensure parameters

are not exceeded at any point of time. This pilot has to have a feel of the helicopter and cannot be achieved by flying the helicopter mechanically.

1.18.4 Civil Aviation Requirements – Training (flight crew)

Civil Aviation Requirements on flight crew training and qualification for commercial helicopter operations are given under Section – 8, Series 'H', Part II. Para 6 following is mentioned:

Para 6CONVERSION TRAINING (TYPE RATING)

6.1 Conversion training on a type of helicopter may be carried out as follows:

6.1.1 By undergoing a type rating course at an ATO. In this case, requisite ground training, written test, flying training and skill tests shall be carried out at the ATO, details of which shall be submitted to DGCA for licence endorsement. No prior permission or NOC is required from DGCA for such training.

6.1.2 If operator wishes to do flying training of his pilot on own company helicopter then the pilot has to undergo ground course and simulator (when part of the approved course) at an ATO, before undertaking flying training with a DGCA approved TRE/ TRI. The flying training syllabus to be followed shall be approved by DGCA.

6.1.3 In case no ATO exists for a particular type of helicopter in India or abroad, conversion on type may be carried out by undergoing a prescribed ground and flying training syllabus under the aegis of a DGCA approved TRI/TRE. The conduct of such training, and the ground and flying training syllabus to be followed shall be approved by DGCA on a case-to-case basis. In this case, the pilot shall pass the prescribed DGCA CEO written examination on successful completion of ground training, after which he shall undergo flying training under a DGCA approved TRI/TRE. On completion of training he shall undergo Skill Test(s) under a TRE towards completion of type rating. Details shall be submitted to DGCA for licence endorsement.

6.1.4 The instructional flying training and Skill Tests shall not be flown with the same Instructor / Examiner.

Further Para 11.1 of the CAR deals with flight crew training (special) and qualification for commercial helicopter operations (Hill/ Mountain Flying Operations) which are as below:

11.1 Hill/ Mountain Flying Operations

11.1.1 Training Requirements to upgrade to PIC in Hills.

If pilot has no previous experience in Hill Flying, then on completion of training mentioned below, the pilot shall thereafter operate as co-pilot for a minimum duration of 1year and 100 hrs, whichever is later. Thereafter he shall undergo a Hill Ops Release Check with TRE/ TRI before being cleared to operate as PIC in Hills.

Flying training mentioned in the table below may be carried out either on the helicopter or on a FFS Level B/C/D or FTD 6/7 (FAA Designation) which is cleared for hill operations training. Upto 50% of flying training may be carried out on FFS B/C/D or FTD 6/7 (FAA Designation) specifically cleared for the purpose. However, Hill Ops Release Checks shall be carried out only on the helicopter and minimum 03 landings shall be carried out on at least 03 different helipads at/ above 4000 Feet AMSL. The flying training mentioned below may be carried out in revenue flights.

Total Flying Hours	Experienced in Hills/Mtns	No previous experience
Less than 1000 hrs total flying experience including 250 hrs PIC on helicopters.	2 hrs Flying training with TRE/TRI + Hill Ops Release Check 0:45 hrs.	Ground Training + 15 hrs Flying training with TRE/TRI + Hill Ops Release Check 0:45 hrs.
1000 hrs and above total flying experience including 250 hrs PIC on helicopters.	1 hr flying training with TRI/TRE + Hill Ops Release Check 0:45 hr.	Ground Training + 10 hrs Flying training with TRE/TRI + Hill Ops Release Check 0:45 hrs.

11.1.2 Missing

11.1.3 ------

11.1.4 -------

11.1.5 Ground Training. The ground training specific to hill/ mountain operations, where applicable, shall be conducted for a duration of at least 4 hours at a DGCA approved GTO/ ATO or by a TRE/ TRI/ Check Pilot/ Chief Pilot as follows:

11.1.6 Recent Experience.

11.1.6.1 A previously cleared pilot who has not carried out Hill/ Mountain Flying in the last 12 months preceding the date of operations shall fly a Hill Ops training sortie of 0:45 hr followed by Check sortie of minimum 0:45 hr duration, with a TRE / TRI before being permitted for independent operations.

11.1.6.2 A previously cleared pilot who has not carried out Hill/Mountain Flying in the last 24 months or more shall undergo ground refresher of 2:00 hrs duration followed by training flight with TRE/TRI of 1:30 hr, followed by a Hill Ops Check of 0:45 hrs on the helicopter with a TRE/TRI.

1.18.3 Civil Aviation Requirements (Weight & Balance)

In Civil Aviation Requirements Section 2 - Airworthiness Series 'X' Part-II on Weight And Balance Control of Aircraft, it is mentioned that “For preparation of load sheet and calculation of Centre of Gravity as mentioned in para 9.4 above, the minimum standard weight (including handbag) as given below, shall be applied in all civil registered aircraft:

1.	Crew	85 (75+10) kg.
2.	Adult passenger (both Male & Female)	75 kg.
3.	Child (Between 2 years and 12 years age)	35 kg.
4.	Infant (Less than two years)	10 kg.

Further it mentions that notwithstanding the above Para, the actual weight of the passenger could be considered for aircraft MTOW up to 2000

Kgs provided the arrangement for passenger weighment with sufficient accuracy is ensured.

1.18.4 Standard Operating Procedure (SOP)

The approved Operations Manual (helicopter) CAP 8100 part- A of the Operator contains SOP for Chaar Dhaam. As per this SOP, “Helicopter operations in Uttarakhand sector are very dense owing to inaccessible areas a large portion of this flying is done towards the Chaar Dhaam pilgrimage. Flying in this sector needs special care and precautions along with adequate crew qualifications, as most of this flying is done in hills and medium to high altitudes. The other associated hazards in this sector are as follow:-

a) High density of helicopter traffic especially during the pilgrimage season.
b) Certain areas are prone to serve turbulence due to high wind velocities, which can be extremely dangerous especially during take-off and landing phases.
c) Most of the helipads do not have the prescribed clear areas for take-off and landing, and hence need to be operated in OGE configuration.
d) Weather can deteriorate with inadequate warning especially during later part of the day.”

1.19 Useful and Effective Techniques:

Nil

2 Analysis

2.1 Chaar Dhaam Operations

2.1.1 General - Chaar Dhaam

Chaar Dhaam Yatra in the State of Uttarakhand commences with opening of 04 shrines from beginning of May and continues till end of October every year. To facilitate the pilgrims for Chaar dhaam Yatra helicopter services in the form of Charters are provided by various operators.

Pilgrims comes from various parts of India and also from world over to visit the Holy shrines situated in the Himalayas at & above 10,000 feet AMSL.

2.1.2 Helipad at Badrinathji

Ledge at the helipad end (towards take off direction)

Power line (crossing flight path) above the wreckage

2.1.3 Operational approval process

Operators willing to provide charter services for Chaar Dhaam Yatra apply for permission to the Govt. of Uttarakhand.

The committee has not come across any laid down procedure/ criteria for issuance of permission by the State Govt. to the operators for Chaar Dhaam charters. However on application of the operators State Govt. of Uttarakhand normally issues permissions to the operators to operate Chaar Dhaam charters. After obtaining permission from the State Govt. the operator starts operating the charters to the Chaar Dhaam.

The helipads normally utilised for these charters are of State Govt. (UCADA) i.e. Sehastradhara, Kharsali, Harsil, Badrinathji. These helipads are inspected by the DGCA before start of Chaar Dhaam operations normally April end. After the inspection DGCA intimates the observations to the State Govt. i.e. owner of the helipads for ensuring compliance of the observations before commence of operations.

DGCA has carried out inspection of Sahastradhara, Harsil, Badrinathji and Kharsali helipads in April / May 2017 and intimated UCADA that these helipads lack basic infrastructure rendering these unsafe for conduct of operations. A compliance report was sought by 31st May 2017. However there had been no communication on the subject from UCADA though operations

were started. On 10th June 2017 (the date of accident), DGCA suspended all operations to these helipads till further orders.

In order to avoid delay in start of Chaar Dhaam charters, operators step forward and carry out the compliance of the observations raised by DGCA. However no inspection is carried out by the State (owner of the helipad) after the compliance.

2.2 Helicopter

2.2.1 Serviceability & Maintenance

The Certificate of Registration, Certificate of Airworthiness and ARC was valid on the day of accident. The helicopter had logged 431:20 airframe hrs as on date of accident. The helicopter and its engine were maintained as per approved continuous maintenance programme based on calendar period or flying hours/ cycles.

The last major inspection i.e. 400 hrs scheduled inspection was carried out at 354:15 airframe/engine hours on 24th April 2017. Subsequently all lower inspections, after last flight inspection and pre-flight checks were carried out as and when due before the accident. All the applicable Airworthiness Directive, Service Bulletins, DGCA Mandatory Modification on this helicopter and its engine have been complied with as & when due.

There was no snag or defect, pending or reported before the accident or during the accident flight. The helicopter was fully serviceable for operating the flight and maintenance aspect has not contributed to the accident.

2.2.2 Engine Investigation

The involved engine after preliminary external examination and BSI at Mumbai was subjected to thorough investigation at the Manufacturers' facility. It has not showed any signs of impact damage with the exception of deformation seen on the fuel manual over-ride linkages. There was no evidence of pre-impact anomalies found on the compressor. The compressor turbine blades contained no signs of damage or rubbing.

The centrifugal compressor showed signs of rubbing with the centrifugal impeller shroud. There was evidence of the power turbine blades rubbing with the power turbine shroud. The sprag clutch was found seized. All these indicated that at the time of sprag clutch seizure the engine was driving the helicopter rotor.

The Engine Electronic Control (EEC) was downloaded and an Nr event and N_f critical fault observed indicating a loss of signal or rotation of the main rotor which is driven by the power turbine (N_f). This is also consistent with the findings of the sprag clutch seizure due to a main rotor stoppage.

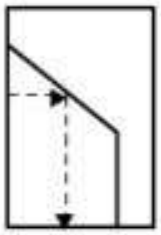
There was no damage in either the reduction gearbox or accessory gearbox besides normal wear. The Power Turbine Governor, Electronic Governing Unit (EGU), flow divider, Fuel Control Unit (FCU), and fuel pump were all tested and there were no findings that would have impacted normal flight operations.

2.2.3 Performance

Performance capabilities during take-off from Badrinathji Helipad was analysed by using various charts for calculating hover Ceiling In-Ground-Effect (IGE) and Out of Ground Effect (OGE) both for Take-off Power (TOP) and Maximum Continuous Power (MCP) given in the Rotorcraft Flight Manual (RFM) of the helicopter.

In case MCP was used the weight reduces to 2420 kgs under HIGE conditions. Similarly in case the helicopter is in HOGE conditions, other environmental conditions remaining same, for TOP and MCP, the max. AUW are 2400 & 2140 kgs respectively. In the following pages the values as mentioned above are shown on the respective charts as mentioned in the RFM and also provided in the report of the helicopter manufacturer.

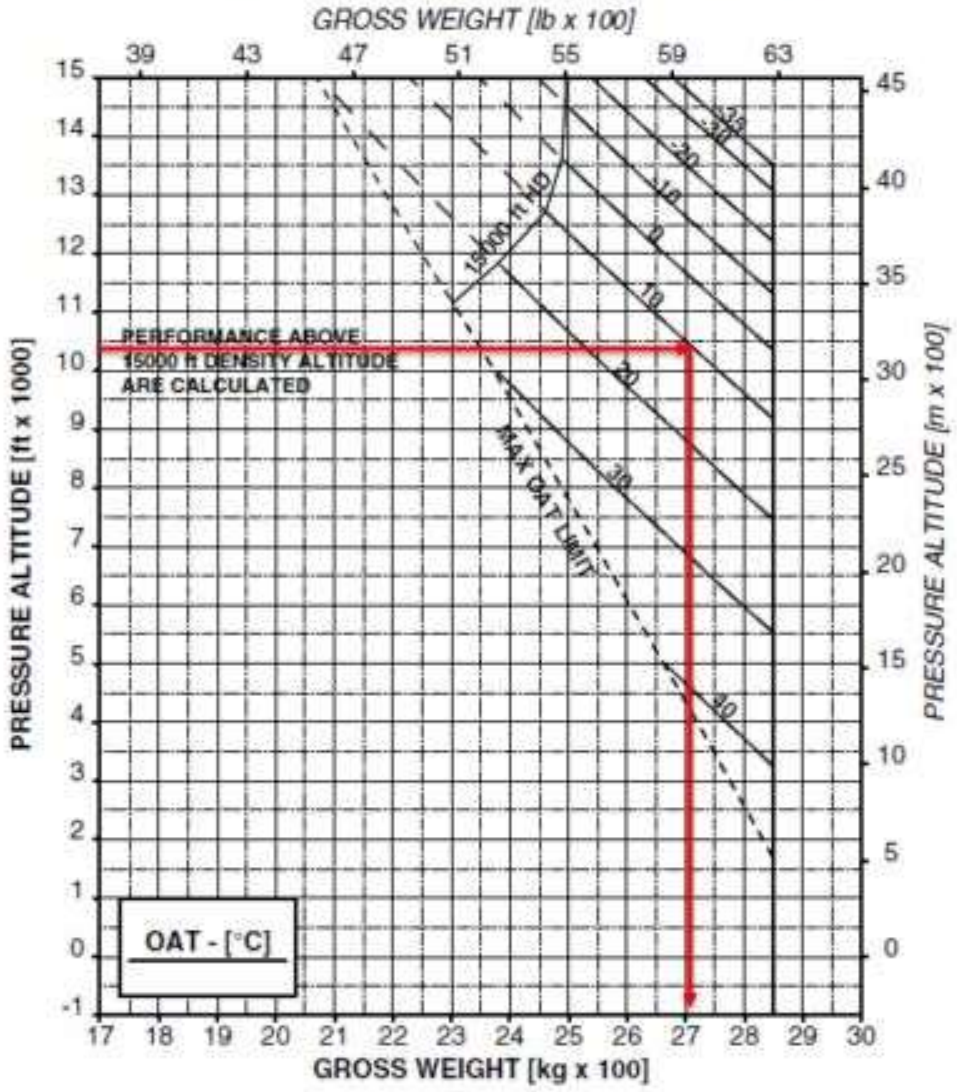
HOVER CEILING IN GROUND EFFECT
TAKE-OFF POWER



ROTOR SPEED:102%
ZERO WIND

ELECTRICAL LOAD: 100 A
SKID HEIGHT: 3 ft

WITH ELECTRICAL LOAD IN EXCESS OF 100 A REFER TO CORRECTION TABLE

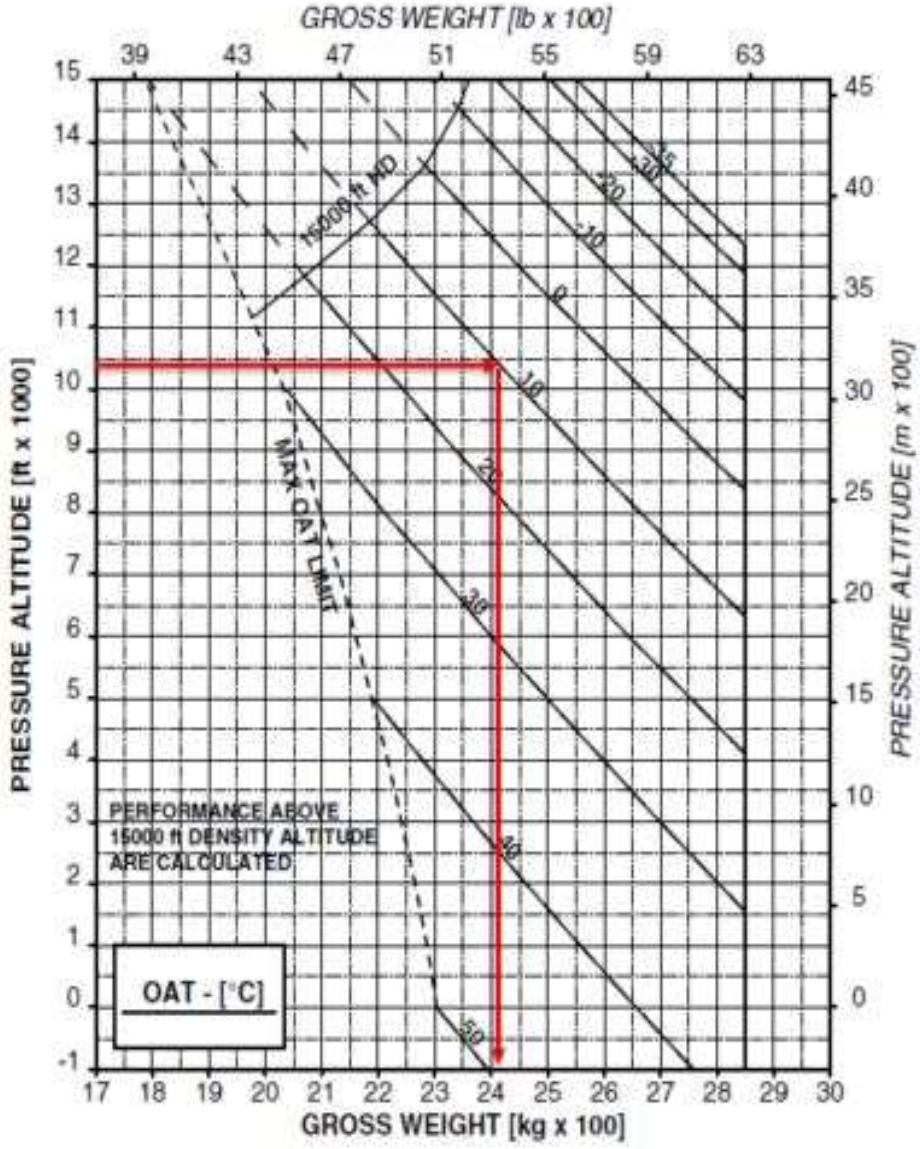


HOVER CEILING IN GROUND EFFECT
MAXIMUM CONTINUOUS POWER

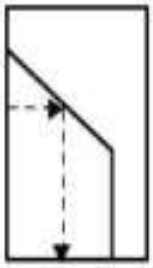
ROTOR SPEED:102%
ZERO WIND

ELECTRICAL LOAD: 100 A
SKID HEIGHT: 3 ft

WITH ELECTRICAL LOAD IN EXCESS OF 100 A REFER TO CORRECTION TABLE



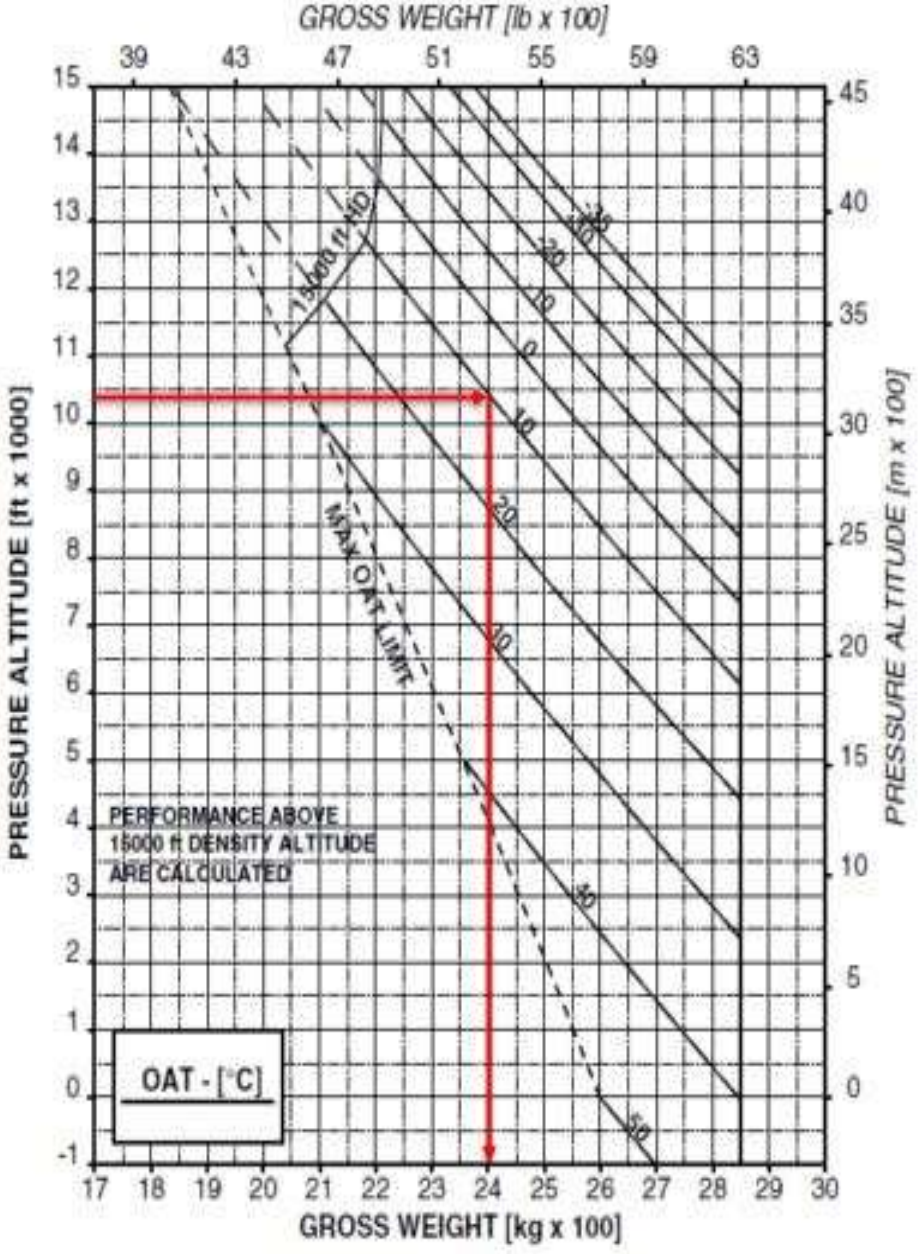
HOVER CEILING OUT OF GROUND EFFECT
TAKE-OFF POWER



ROTOR SPEED:102%
ZERO WIND

ELECTRICAL LOAD: 100 A

WITH ELECTRICAL LOAD IN EXCESS OF 100 A REFER TO CORRECTION TABLE

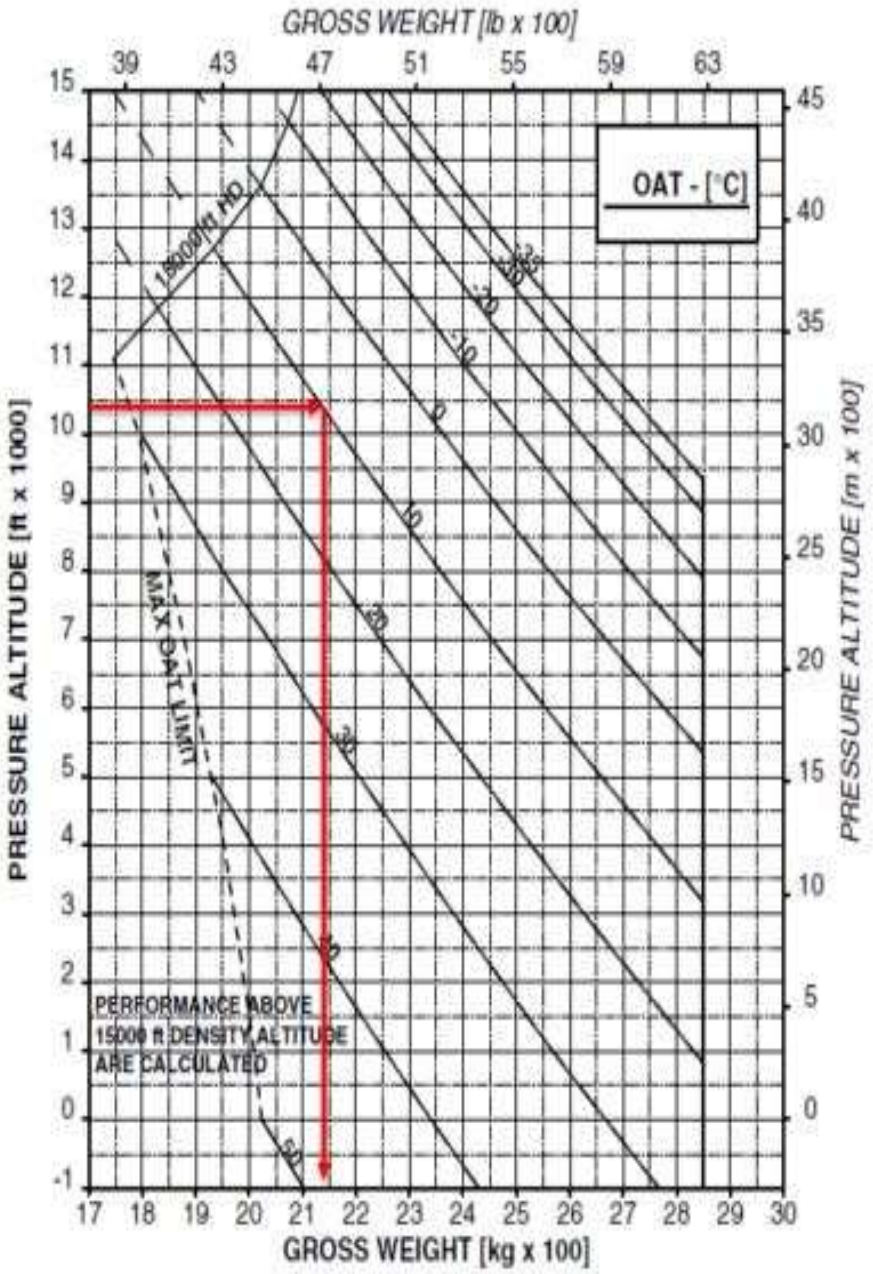


HOVER CEILING OUT OF GROUND EFFECT
MAXIMUM CONTINUOUS POWER

ROTOR SPEED:102%
ZERO WIND

ELECTRICAL LOAD: 100 A

WITH ELECTRICAL LOAD IN EXCESS OF 100 A REFER TO CORRECTION TABLE



As per the Load & Trim Sheet, the estimated AUW of the helicopter at the time of take-off was 2681 kgs. As per the PF, they had performed a “Hover check” prior to leaving the Helipad, which if the take-off power was being used under HIGE conditions gives a maximum AUW of 2710 kgs. The AUW was therefore within limits.

According to the above calculations, though the capability of the helicopter was within limits (HIGE / TOP) but marginal. Helicopter would not have been able to perform under HOGE conditions using Take-Off Power (TOP) in the reported conditions.

PM in her statement has stated that the PF came up on power to arrest the rate of descent and tried to utilize the yellow margin of ITT to arrest the sink but it didn’t help…. . The yellow range of the ITT scale (755 to 810°C in cruise mode) corresponds to the TOP rating, while the green arc (0 to 755°C) corresponds to MCP. It appears therefore that the Crew tried to use the take-off power only for arresting the sink.

The helicopter was only 2 years old at the time of the accident and it had logged far less flight hours (~ 432 hrs.), it is possible that the helicopter had still power margins over the minimum specified for the engine, therefore allowing it to achieve higher performances w.r.t the RFM in given conditions, where the transmission system is not a limiting factor.

It may be noted that the published performances are based on a conservative approach, considering that the helicopter is equipped with an engine which is delivering the minimum specified power in every environmental condition. Practically, the available power is always slightly higher than the minimum published, provided that the engine is properly maintained and periodic Power Assurance Checks are conducted.

From the above discussions it can be concluded that the helicopter AUW was within TOP limits for HIGE conditions and it had taken off safely under HIGE conditions clearing the flight above the helipad surface without any problem.

2.3 Flight Crew

2.3.1 Experience

The two flight crew operating the accident flight had joined the operator in March 2017. The PF had around 2900 Hours of total flying experience and the co-pilot had around 1900 hours of total flying experience on different helicopters not including the type of accident helicopter on the date of joining the services of the operator.

2.3.2 Training on AW119 MKII

After joining the organisation, the PF was subjected to conversion training on AW119 MKII helicopter after getting approval from the DGCA, which included 30 hours of theoretical course for initial rating carried out at Manufacturers' facility in Italy. On 19.04.2017 he was subjected to Skill test by day & night of 00:45 hours each under the supervision of DGCA Type rated examiner, after which he got the endorsement on 28.04.2017 and started flying the type of helicopter.

After few hours of flying covering a weeks time after endorsement, the flight crew was deputed for carrying out Chaar Dhaam flying. The PF was released for hill flying after 11 hours of hill flying with Instructor/ Examiner. The area flown while attaining the hill experience was the Chaar Dhaam routes. Though the PF was released on 23rd May 2017, he continued to fly as co-pilot (PM) for about 22 hours till 6th of June 2017.

Similarly, the PM joined the present operator in March 2017. After joining she underwent conversion training on AW119 MKII helicopter which also included 30 hours of theoretical course for initial rating carried out at Leonardo Helicopters, Italy. After successful completion of the above, she was subjected to Skill test by day & night of 00:45 hours each under the supervision of DGCA Type rated examiner. After getting endorsement, she started flying AW119 MKII .

After endorsement, she flew for a week's time in Mumbai and was then deputed for carrying out Chaar Dhaam flying and was released on 19th May 2017 for hill flying as PF after 15:30 hours of hill flying with Instructor/ Examiner. She was flying as PF since then. The area flown while attaining the hill experience was the Chaar Dhaam routes.

2.4 Circumstances leading to the accident

The operator had started Chaar Dhaam operations for the first time this year i.e. 2017 with two Agusta AW 119 helicopters including the subject accident helicopter. As per the permission granted by the State Government the operator was permitted to operate to various helipads including Badrinathji till 25th of June 2017.

After joining the operator both of the flight crew members were subjected to conversion training on AW119 MKII helicopter as per the existing CAR on the subject, which included 30 hours of theoretical course for initial rating which was carried out at the manufacturers facility, 06 hours of flying training by day (including test by day), 02 hours of flying training by night (including test by night). The skill test by day & night of 00:45 hours each were carried out under the supervision of DGCA Type rated examiner. Both of them got AW119 MKII endorsed on 28.04.2017.

After few hours of flying covering a weeks time after endorsement, the flight crew was deputed for carrying out Chaar Dhaam flying. The PF was released for hill flying after 11 hours of hill flying with Instructor/Examiner. Similarly the co-pilot was released for hill flying after 15:35 hours of hill flying with Instructor/Examiner**.** The area flown while attaining the hill experience was the Chaar Dhaam routes. During these flights the routing for various helipads, the altitudes to be maintained, mandatory reporting points, bad weather routes, the particulars of all the helipads were discussed and briefed by the Instructor/Examiner.

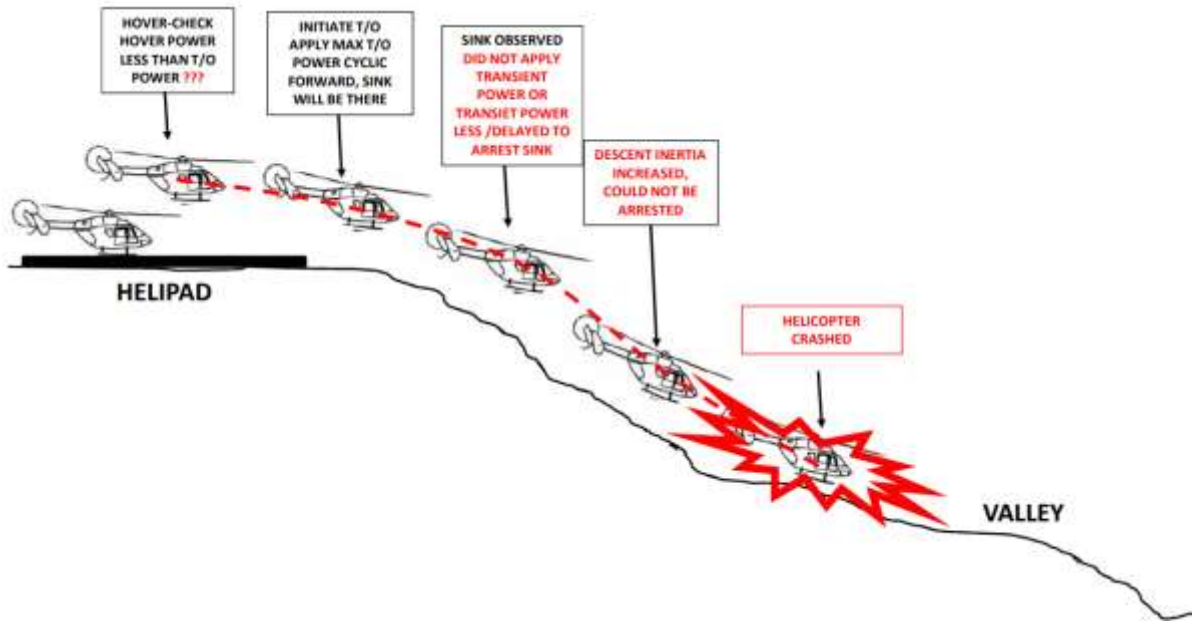
Though the PF was released on 23rd May 2017, he continued to fly as co-pilot for about 22 hours till 6th of June 2017. On 8th of June 2017 the PF undertook his first PIC sortie in hills with a line pilot as co-pilot from Haridwar – Kharsali – Harsil which was uneventful. The next day the same crew was supposed to operate from Harsil – Guptkashi – Badrinathji – Haridwar. Due to bad weather at Badrinathji the last leg from Badrinathji to Hardiwar was not flown and the helicopter had to make a night halt at Badrinathji.

On 10th June 2017 before carrying out the flight for Hardiwar PF carried out pre-flight checks and all the parameters were observed to be normal. The

weather at that time was fine, with calm winds and outside air temperature around 10^{o}C. After all the passengers boarded the helicopter the pilot started engine and carried out a hover check. There was no abnormality observed. The pilot then commenced take-off.

Since the pilot had commenced takeoff from the closest front edge of the ledge helipad towards Joshimath, soon after takeoff the helicopter encountered HOGE conditions. As soon as the helicopter encountered HOGE conditions from HIGE conditions, with almost full pay load, the PF felt natural sink which he tried to arrest by raising the collective. Unable to arrest the sink and being aware of the cables which he thought might obstruct his path; he tried to put the helicopter on ground in front of him by lowering the collective.

On lowering the collective, the helicopter yawed to the left. The right rudder correction probably was more than required, which consumed power and the helicopter turned towards right by around 60-70 degrees from its flight path. Finally the helicopter impacted the ground below the electric cables which converge with the following flight path.



The pilot shut off the fuel valve and then switched off the battery. All the passengers evacuated the helicopter from left emergency window. Both the

cockpit crew then came out of the helicopter from their respective side. There was no injury reported to any of the passengers. The crew escaped with minor injuries. However the AME on board the helicopter received fatal injuries. The AME was reported to have vacated the helicopter prior to the other occupants and was hit by the Main Rotor Blades when the Rotor was still turning at high speed. The helicopter was substantially damaged during the accident. There was no fire.

3 CONCLUSION

3.1 Findings

1. The Certificate of Registration, Certificate of Airworthiness & Certificate of flight release of the helicopter was valid on the date of accident.
2. The helicopter and its engine were being maintained under continuous maintenance programme approved by DGCA.
3. The helicopter was operated within the Centre of Gravity and Weight limits with almost full payload.
4. Compliance report on the observations intimated to UCADA on 17th May 2017 indicating lack of basic infrastructure rendering certain helipads including Badrinathji unsafe was not received by DGCA (though were to be submitted by 31st May 2017) till the date of accident though operations from these helipads were continuing.
5. The flight crew was having valid licences with appropriate endorsements issued by DGCA. They had current medical and fulfilled all other regulatory requirements.
6. The PF has a total flying experience of about 2900 hours out of which a total of 58:30 hours were on type and 29:30 hours were as PIC on type. The PM had a total flying experience of 1902 hrs out of which about 61 hrs was on type.
7. The PF has operated his first PIC sortie(s) after release on type in hills with a line pilot as co-pilot from Haridwar – Kharsali – Harsil on 8th of June 2017 and from Harsil – Gupt Kashi – Badrinathji on 9th of June 2017. The PM of the accident flight was also operating as PM for these flights. These sectors were part of Chaar Dhaam Yatra and were uneventful.

8. On 10th June 2017 the crew carried out pre-flight checks, hover check and engine parameters check of the helicopter which was parked on the closest front edge (ledge) of the helipad towards Joshimath. As there was no abnormality observed, the pilot commenced take-off.

9. The weather was fine with calm winds and OAT of 10^{o} C.

10. The take-off was from the closest point of helipad in the direction of flight from a ledge helipad causing sudden transition from HIGE to HOGE conditions

11. As soon as the helicopter encountered HOGE conditions from HIGE conditions, with almost full pay load, power setting was probably not adequate to sustain flight and the PF felt the natural sink which he tried to arrest by raising the collective.

12. Unable to arrest the sink and being aware of the cables which he thought might obstruct his path; he tried to put the helicopter on ground in front of him by lowering the collective.

13. On lowering the collective, the helicopter yawed to the left which the PF corrected by applying right rudder. Probable overcorrection to the right consumed power and helicopter turned towards right by around 60-70 degrees from its flight path.

14. Finally the helicopter impacted the ground below the electric cables which converge with the flight path. The damages suffered were accident-consequential with no component showing a progressive failure mode or indications of pre-existing failures.

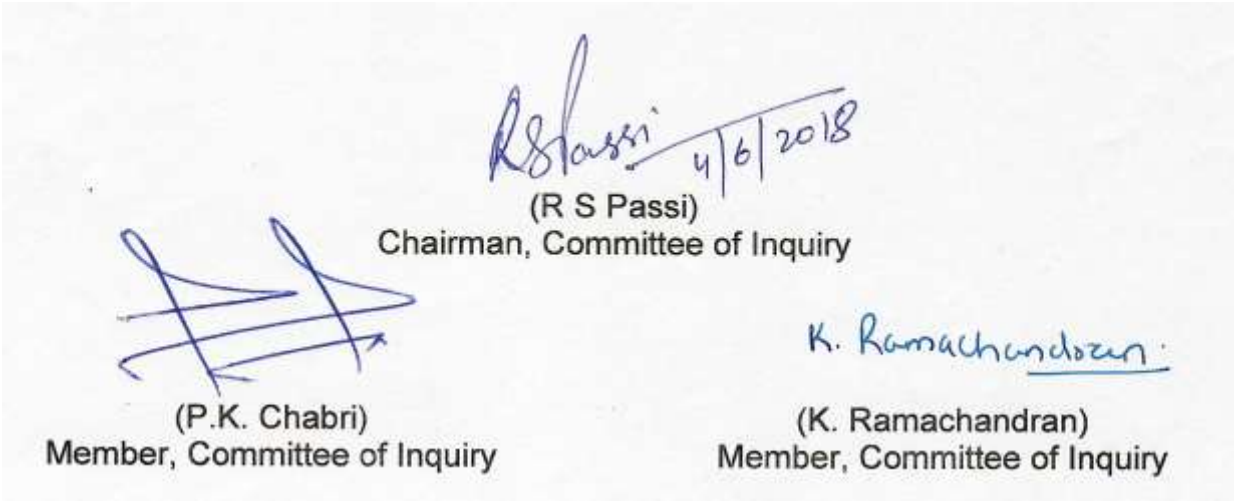
15. The AME who vacated the helicopter before it impacted the ground was hit by the Main Rotor Blades when the Rotor was still turning at high speed.

3.2 Probable Cause of the Accident

After lift-off in HIGE conditions, from the closest point on ledge helipad in the direction of flight, as soon as the helicopter encountered HOGE conditions, it sank which was probably not appropriately controlled resulting in the helicopter impacting the ground with substantial damages and fatal injury to one of the occupants who came out of the helicopter when the main rotor blades were still in motion.

4 Recommendations

- The State of Uttarakhand may develop documented procedures for clearance, monitoring and control of Chaar Dhaam Operations with clear timelines of the processes involved from administrative point of view.
- The State of Uttarakhand may consider providing all the infrastructure at the helipads owned by the Government well in advance of the beginning of Chaar Dhaam Yatra by helicopters in association with DGCA.
- The State of Uttarakhand should relocate the existing power line which is in the flight path just after take-off (though below) of the flights taking off from Badrinathji.
- DGCA must ensure that the observations made during the audits / surveillance rendering the helipads unsafe for conduct of operations is rectified and compliance report submitted before commencement of operations from Badrinathji helipad.



DATE: 4th June 2018

PLACE: New Delhi

Annexure I


Portion of lower surface of the tail boom skin was found punctured and severely damaged.


VHF antenna was found damaged


Anti-collision light below tail boom was found Broken


Tail rotor Guard Severed from the tail
boom structure
Marks of Main rotor blade impacting ground


Main Gear Box support beams were broken


MGB Support frames were damaged


Damage to Left Horizontal stabilizer

Annexure II


Marks of main rotor blade impact on ground


Marks of Main Rotor blade impacting with ground


Trees cut by main rotor blades


Trees cut by main rotor blades


All the Cockpit switches and circuit breakers were found in positions as is after an emergency shutdown.


Emergency Window Opened
(Passengers vacated through
Emergency)