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FINAL REPORT OF SERIOUS INCIDENT INVOLVING AIRBUS A320 (NEO) AIRCRAFT VT-WGLOPERATED BY M/s GO AIRLINES (INDIA) LIMITED ON 23RD - DECEMBER 2019

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(Investigator)

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 shall be the prevention of accidents and incidents and not to apportion blame or liability. The investigation conducted in accordance with the provisions of above said rules shall be separate from any judicial or administrative proceedings to 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 future accidents or incidents could lead to erroneous interpretations.

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GLOSSARY	
AAIB	Aircraft Accident Investigation Bureau
AOP	Air Operator Permit
ARC	Aircraft Review Certificate
ASDA	Accelerate Stop Distance
ASR	Area Surveillance Radar
ATB	Air Turn Back
ATC	Air Traffic Control
BECMG	Becoming
CAR	Civil Aviation Requirement
CEO	Current Engine Option
DGCA	Directorate General of Civil Aviation
EGT	Exhaust Gas Temperature
ENG	Engine
ESN	Engine Serial Number
ETA	Estimated Time of Arrival
ETD	Estimated Time of Departure
GTB	Ground Turn Back
HPC	High Pressure Compressor
ICAO	International Civil Aviation Organization
IDG	Integrated Drive Generator
IFSD	In-Flight Shut Down
LDA	Landing Distance Available
LPT	Low Pressure Turbine
LSOP	Lube & Scavenge Oil Pump
MCT	Maximum continuous Thrust
MGB	Main Gear Box
NEO	New Engine Option
NO SIG	No Significant
NTSB	National Transport Safety Board
OEM	Original Equipment Manufacturer
PIC	Pilot in Command
QRH	Quick Reference handbook
RESA	Runway End Safety Area
RTO	Rejected Take-Off
SB	Service bulletin
SCT	Scattered
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid-State Flight Data Recorder
TLA	Throttle liver angle
TODA	Take-off Distance Available
TORA	Take-off Run Available
TWR	Terminal Weather Radar
UTC	Coordinated Universal Time

FINAL REPORT OF SERIOUS INCIDENT INVOLVING AIRBUS A320 (NEO) AIRCRAFT VT-WGLOPERATED BY M/s GO AIRLINES (INDIA) LIMITED ON 23RD -DECEMBER 2019.

1.	**Aircraft**	**Type**	**:**	Airbus A320(NEO)
		Nationality	**:**	Indian
		Registration	**:**	VT-WGL
2.	**Owner & Operator**		**:**	Go Airlines (India) Limited
3.	**Pilot**		**:**	ATPL Holder
	Extent of Injuries		**:**	Nil
4.	**Co- Pilot**		**:**	CPL Holder
	Extent of Injuries		**:**	Nil
5.	**No. of Passengers on board**		**:**	134
6.	**Date & Time of Serious Incident**		**:**	23rdDecember 2019at 0550 UTC
7.	**Place of Serious Incident**		**:**	Guwahati Airport
8.	**Co-ordinates of Incident Site**		**:**	Lat: 26°06’22” N Long: 91°35’09” E.
9.	**Last point of Departure**		**:**	Guwahati Airport
10.	**Intended landing place**		**:**	Kolkata Airport
11.	**Type of Operation**		**:**	Scheduled Operation
12.	**Phase of operation**		**:**	Climb
13.	**Type of Serious Incident**		**:**	System/Component Failure or Malfunction (Powerplant)

(All the timings in this report are in UTC unless otherwise specified)

SYNOPSIS

On 23rd December 2019, Airbus A320 aircraft VT-WGL operated by M/s Go Air carried out an air turn back due to high engine vibration while operating a scheduled flight from Guwahati to Kolkata. Aircraft landed safely at Guwahati.

The aircraft was under the command of an ATPL holder, who was Pilot Flying (PF) with a co-pilot, a CPL holder, who was Pilot Monitoring (PM). There were 134 passengers on board the aircraft with 04 cabin crew members.

The aircraft took-off from Guwahati airport and while climbing passing 1500ft altitude a loud bang sound was heard by the flight crew. Subsequently, “Engine stall” and “High Engine Vibration” ECAM warning message triggered for engine # 1. The crew carried out the ECAM and QRH procedures. As the engine vibration was continuous and parameters were fluctuating, the crew decided to return to Guwahati. The aircraft landed safely at Guwahati. On visual inspection from the rear side of the engine almost all Low-Pressure Turbine (LPT) blades were found burnt and broken from the tip.

The occurrence was classified as a Serious Incident by AAIB and Sh. Jasbir Singh Larhga, Deputy Director, AAIB was appointed as Investigator – In – Charge along with Sh Amit Kumar, Safety Investigation Officer as Investigator to investigate into the probable cause(s) of the serious incident, vide Order No. INV.12011/25/2019-AAIB dated 23rd December 2019 under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017.

1 FACTUAL INFORMATION

1.1 HISTORY OF THE FLIGHT

On 23rd Dec 2019, M/s Go Air Airbus A320 (NEO) aircraft VT-WGL was scheduled to operate flight G8-546 from Guwahati to Kolkata. There was no abnormality reported on the aircraft during any previous flight of the day. The aircraft was scheduled to depart from Guwahati at 05:30 UTC and arrive in Kolkata at 06:55 UTC.

There were 133 passengers on board and flight was operated by 02 cockpit crew and 04 cabin crew. The aircraft took-off from Guwahati at around 05:46UTC. Immediately after take-off, while climbing passing 1500ft, a loud bang was heard by the crew. Subsequently, “Engine Stall” followed by “High Engine Vibration” warnings were triggered on ECAM. At 05:47:12 UTC, N1 and N2 vibration for Engine # 1 was 10 units and 3.7 units respectively with EGT at 877℃. Within a second N2 vibration also reached up to 10 units. The crew followed ECAM actions and QRH checklist/procedures for High Engine Vibration.

Meanwhile the PIC had taken over the control. The engine#1 power was gradually brought back to IDLE at 05:47:21 UTC. The N1 and N2 vibration was 10 units at that time with EGT at 1011℃. Subsequently, engine # 2 power was changed from CLIMB to MCT. engine # 1 parameters i.e., N1 and N2 vibration continued to remain at about 10 units.

All other engine#1 parameters were also fluctuating. Cabin crew informed the crew about the tail pipe fire seen by them and some passengers. Hence, the crew decided to return to Guwahati and informed ATC Guwahati accordingly, at 0550 UTC. ATC had also confirmed the crew that some metal pieces were found on ground after G8-546 departure. At 05:52:12 UTC, crew carried out precautionary shutdown of engine #1.

After obtaining necessary clearance from ATC, Guwahati, the aircraft landed safely at Guwahati on Runway 02 at 0607 UTC. Overweight landing was not required. The passengers were disembarked normally. There was no fire and no injury to any of the occupants on board the aircraft.

Post landing during visual inspection of the engine exhaust area all blades of Low-Pressure Turbine (LPT) 3rd stage were found damaged.

1.2 INJURIES TO PERSONS

Injuries	Crew	Passengers	Others
Fatal	NIL	NIL	NIL
Serious	NIL	NIL	NIL
~~**Minor**~~**/ None**	02+04	133	—

1.3 DAMAGE TO AIRCRAFT

The aircraft damages due to the incident was limited to its left engine. The LPT 3rd Stage blades of left engine were found broken during inspection. The images of damaged blades is shown below:-

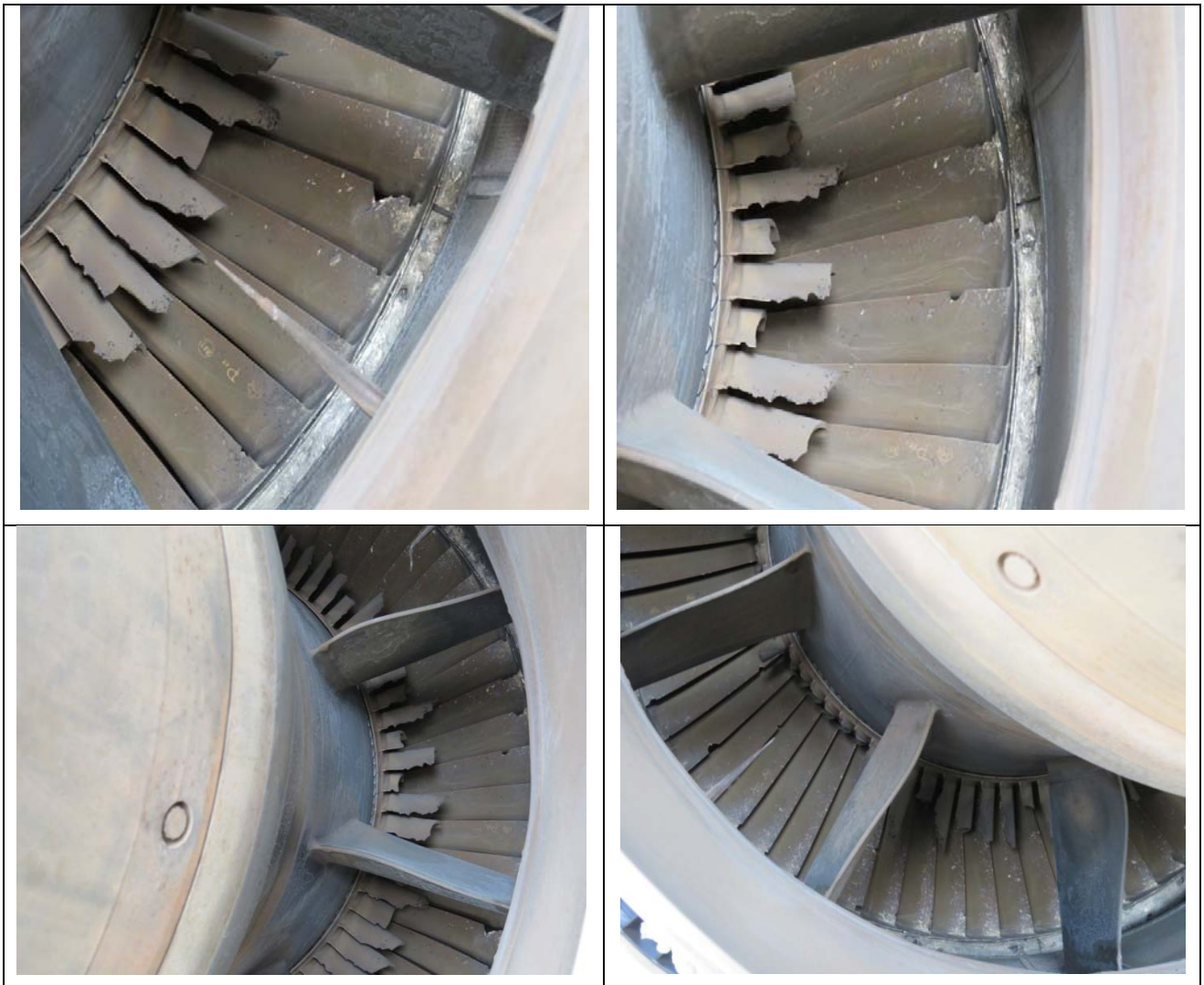

Figure 1: Engine LPT 3rd Stage blades were found damaged during inspection.

1.4 OTHER DAMAGE

Nil

1.5 PERSONNEL INFORMATION

1.5.1 PILOT – IN – COMMAND

Age	40Yrs
License	ATPL
Date of Issue	11 Aug 2014
Valid up to	10 Aug 2021
Date of Class I Med. Exam.	25 Apr 2019
Class I Medical Validity	20 May 2020
Date of issue FRTOL License	04 Jun 2012
FRTO License Validity	03 Jun 2022
Endorsement on Type	13 Oct 2015
Total flying experience	12647:23Hrs
Total flying experience on Type	3019:59Hrs
Last Flown on Type	A320
Total flying experience during last 1 year	791:28 Hrs
Total flying experience during last 6 Months	432:59Hrs
Total flying experience during last 30 days	70:54Hrs
Total flying experience during last 07 Days	19:06Hrs
Total flying experience during last 24 Hours	08:58Hrs
Rest period before flight	23:15Hrs

1.5.2 CO-PILOT

Age	37 Yrs
License	CPL 6014
Date of Issue	14 Jan 2008
Valid up to	13 Jan 2023
Date of Class I Med. Exam.	06 Jun 2019
Class I Medical Validity	24 Jun 2020
Date of issue FRTOL License	14 Jan 2008
FRTO License Validity	13 Jan 2023
Endorsement on Type	22 Mar 2018
Total flying experience	4398:10Hrs
Total flying experience on Type	1440:15Hrs
Last Flown on Type	A 320
Total flying experience during last 1 year	772:25Hrs
Total flying experience during last 6 Months	397:03Hrs
Total flying experience during last 30 days	58:36Hrs
Total flying experience during last 07 Days	21:25Hrs
Total flying experience during last 24 Hours	11:17Hrs
Rest period before flight	20:15 Hrs

1.6 AIRCRAFT INFORMATION

1.6.1 AIRBUS A320 (NEO) AIRCRAFT DESCRIPTION

The Airbus A320is a narrow-body (single-aisle) aircraft with a retractable tricycle landing gear and is powered by two wing pylon-mounted turbofan engines. The A320 family aircraft fitted with new engines were named as NEO (New Engine Option) and the rest were named as CEO (Current Engine Option). These new engines were manufactured with the idea that it will consume less fuel as compared to other engines, reduced CO_2 emissions and reduction in engine noise. A320NEO can be fitted with either:

- The PW1127G-JM, manufactured by Pratt & Whitney or;

- The LEAP-1A, manufactured by CFM International.

The A320 NEO aircraft made its first flight on 25th September 2014 and it was first introduced by Lufthansa on 20th January 2016. A total of 38 operators worldwide are operating A320 NEO family aircraft. After acceptance of Type Certification by DGCA, these A320 NEO aircraft (fitted with PW1127G-JM engines) were inducted by two airline operators in India i.e., M/s Indigo and M/s Go Air.

M/s Go Airlines (India) Ltd had inducted the first A320 NEO aircraft in its fleet on 31st May 2016. The number of A320 NEO family fleet operating in India and globally (as of November 2020) is given below:

	Airlines	**A320 NEO**		**A321 NEO**		**Total**
Global (Including India)	All		**485**		**249**	**734**
India	Indigo	115	**161**	25	**25**	**186**
	Go Air	46		0		

Table: A320/A321 Neo fleet Global vs India.

1.6.2 BRIEF TECHNICAL DESCRIPTION OF PW1127G-JM ENGINE

The PW1127G-JM turbofan engine is an axial-flow, twin spool turbofan engine with an ultra-high bypass ratio, low speed gear-driven fan. Details of engine construction and different engine Modules is shown in the following figures.

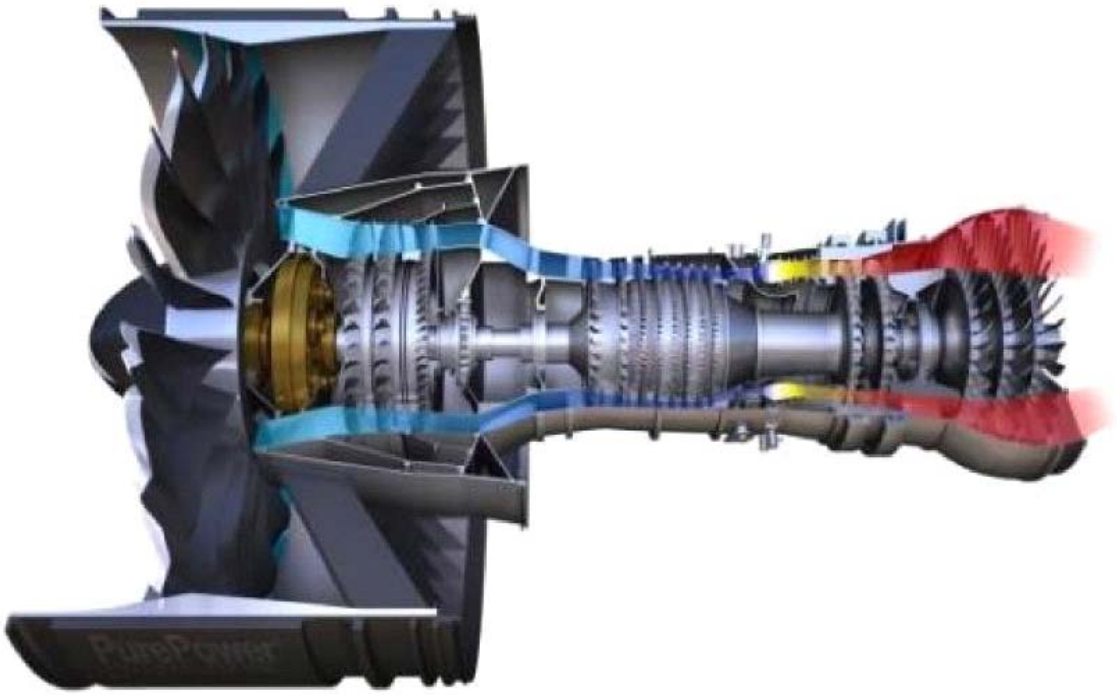

Figure 2: ENGINE CROSS SECTION

The engine comprises of Modules/Build Groups as shown below: -

1. Fan Rotor Group	13. High Compressor Front Case Group
2. Fan Drive Bearing Group	14. High Compressor Rotor Group
3. Fan Drive Gear Group	15. Diffuser Case Group
4. Fan Intermediate Case Group	16. Combustor and Turbine Nozzle Group
5. No. 2 Bearing Group	17. High Turbine Stator Group
6. Fan Case Group	18. High Turbine Rotor Group
7. Low Compressor Stator Group	19. Turbine Intermediate Case Group
8. Low Compressor Rotor Group	20. Low Turbine Stator Group
9. 2.5 Bleed Group	21. Low Turbine Rotor Group
10. Compressor Intermediate Case Group	22. Turbine Exhaust Case Group
11. No. 3 Bearing Group	23. Main Gearbox Group
12. High Compressor Rear Stator Group	24. Angle Gearbox Group

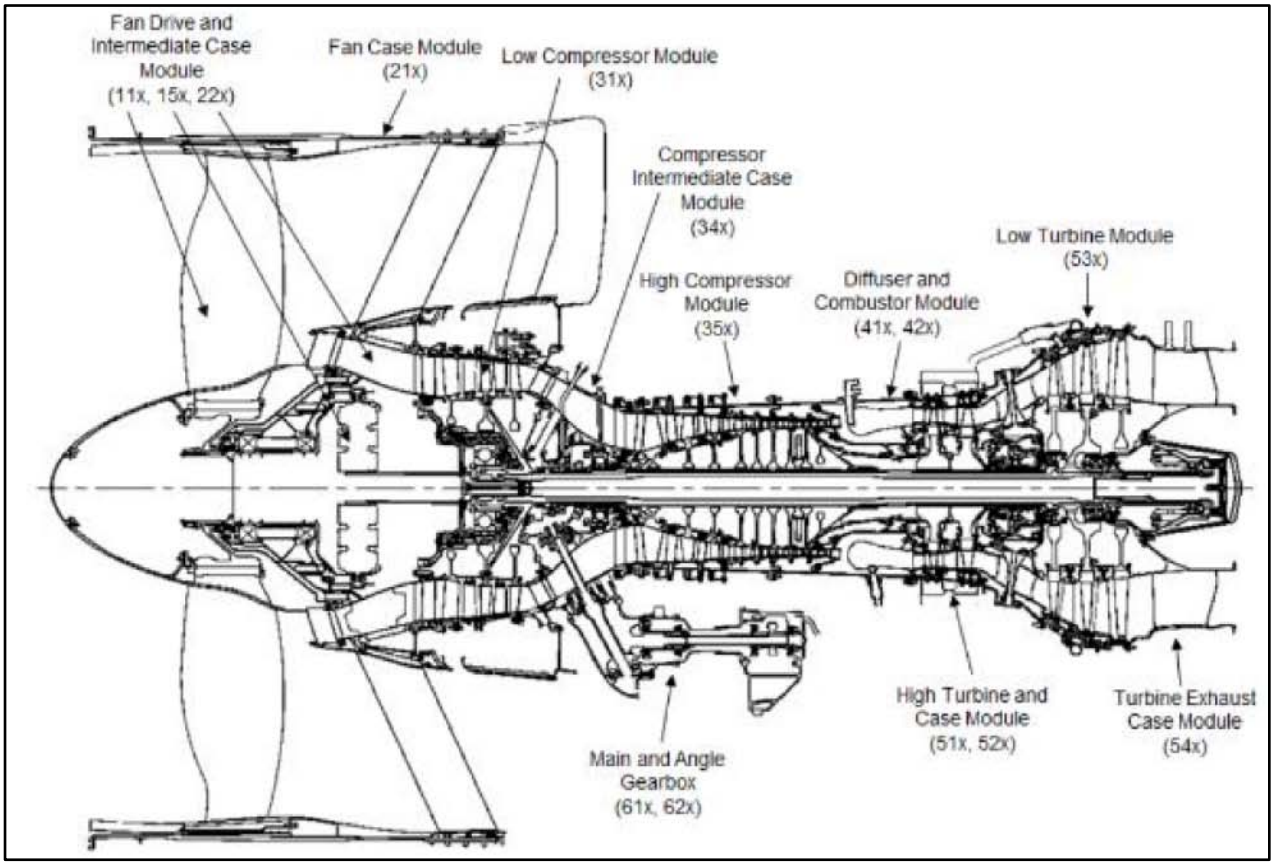

Figure 3: Engine Modules/ Build Group

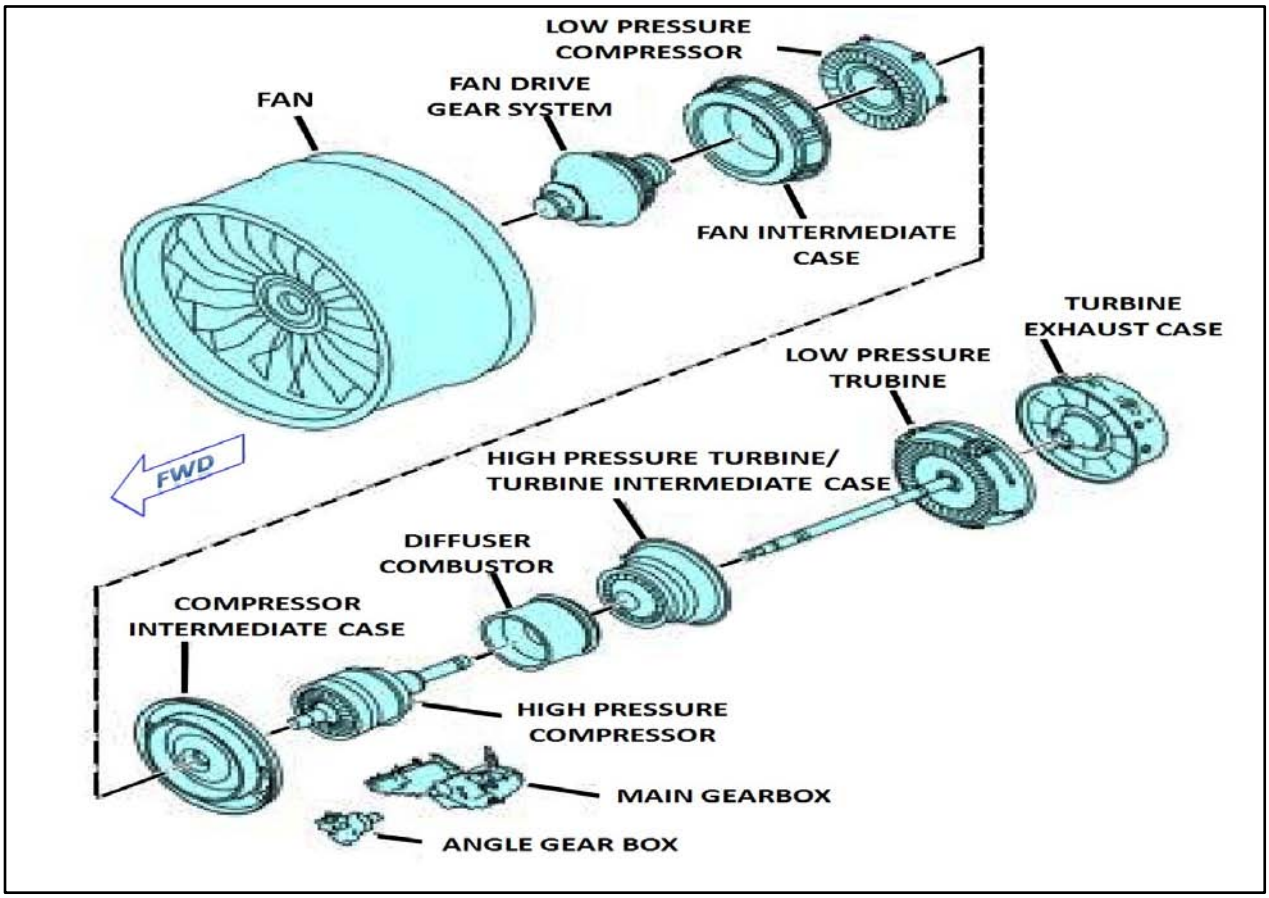

Figure 4: Engine Modules/ Build Group

1.6.3 AIRCRAFTGENERAL INFORMATION: VT-WGL

Aircraft Model	A320-271N
Aircraft Sr. No.	07813
Year of Manufacturer	2017
Name of Owner	GY Aviation Lease 1722 Co. Ltd
C of R	4851
C of A	6954
Category	Passenger
C of A Validity	Valid
A R C issued on	18/12/2020
ARC valid up to	18/12/2021
Aircraft Empty Weight	42441 kg
Maximum Take-off weight	73500 kg
Date of Aircraft weighment	05/09/2019
Operating Empty Weight	43401 kg
Max Usable Fuel	18622 kg
Max Payload with full fuel	11476 kg
Empty Weight C.G	42550 kg
Next Weighing due	05/09/24
Total Aircraft Hours (As on 26/12/2019)	7310:04 hrs / 4431 Cycles
Last major inspection	Not due
Engine Type	PW1127GA-JM
Date of Manufacture (LH)	27/12/2017
Engine Sr. No. (LH)	P770398
Last major inspection (LH)	07/02/2019 (TSN- 2613:26 Hrs / CSN- 1720 Cycles)
Total Engine Hours/Cycles (LH) (As on 26/12/2019)	4997:18 Hrs / 3101 Cycles
Date of Manufacture RH	30/12/2019
Engine Sr. No. RH	P771194
Last major inspection (RH)	Not due
Total Engine Hours/Cycles (RH) (As on 26/12/2019)	1335:15 Hrs / 724 Cycles
Aeromobile License	31/12/2022

All concerned Airworthiness Directives, mandatory Service Bulletins, and DGCA Mandatory Modifications on this aircraft and its engines were complied with as on date of event.

1.7 METEOROLOGICAL INFORMATION

MET Report Guwahati Airport from 0500 UTC to 0700 UTC

Time (UTC)	Wind	Visibility (m)	Clouds	Temp (°C)	Dew Point (°C)	QFE hPa	QNH hPa	TREND
0500	030°/06 kt	1300	SCT 1000 FT	17	17	1012	1018	NOSIG
0530	060°/05 kt	1500	SCT 1000 FT	18	17	1012	1017	NOSIG
0600	020°/05 kt	1700	FEW 1000 FT	18	17	1011	1017	BECMG 3000 BR
0630	050°/04 kt	1800	FEW 1000 FT	19	17	1010	1016	NOSIG
0700	070°/03 kt	1800	FEW 1000 FT	19	17	1010	1016	NOSIG

1.8 AIDS TO NAVIGATION

All Navigational Aids available at Guwahati airport were serviceable. The aircraft was equipped with standard navigational aids and there was no recorded defect with any of the navigational aids during the flight

1.9 COMMUNICATIONS

The aircraft was given take-off clearance by Guwahati TWR (118.75Mhz) at 0545:24 UTC. At the time of incident, the aircraft was in contact with Guwahati ASR on frequency 123.9 MHz. The transcript of relevant communication is placed below:-

Transcript of communication with ASR (123.9 MHz)			
TIME	**FROM**	**TO**	**TRANSMISSION**
0547:04	GOW546	ASR	RADAR NAMASKAR GOAIR546 PASSING 1600 0471
0547:04	ASR	GOW546	GOAIR546 GUWAHATI RADAR IDENTIFIED CLIMB TO FLIGHT LEVEL 260
0547:54	GOW546	ASR	…546 DUE TECHNICAL LEVELLING OFF AT 2000 FEET MA'M GOAIR 546. CAN WE CLIMB TO 3000?
0548:02	ASR	GOW546	AFFIRM SIR CLIMB TO 3500 FEET
0548:06	GOW546	ASR	CLIMB 3500 GOAIR546
0548:24	ASR	GOW546	GOAIR546 CONTACT CONFIRM YOU WILL CONTINUE ON SID
0548:29	GOW546	ASR	NEGATIVE SIR WE ARE MAINTAINING HEADING AS OF NOW AND SIR WE ... I THINK THERE IS OSME PROBLEM IN THE

			ENGINE WE WILL LET YOU KNOW IN ANOTHER MINUTE AND HALF
0550:42	G0W546	ASR	GUWAHATI G0AIR546 SIR WE HAVE HIGH ENGINE VIBRATIONS I THINK PROBABLY WE HAVE REVERTED TO SOMETHING WE MIGHT HAVE TO COME BACK AND LAND IN TO GUWAHATI
0551:03	ASR	G0W546	AND CONFIRM YOU DO NOT NEED ANY KIND OF JETTISONING OR YOU WILL.. CAN DIRECTLY COME FOR LANDING?
0551:09	G0W546	ASR	WE CAN DIRECTLY COME FOR LANDING SIR WE ARE WITHIN MINIMA EVERYTHING AND ... WE DON'T REQUIRE ANY ASSISTANCE ALSO, IF YOU WANT YOU CAN JUST KEEP THE FIRE TRUCKS
0552:57	ASR	G0W546	GOAIR546 CONFIRM REASON IS DUE TO HIGH VIBRATION IN THE ENGINE
0553:01	G0W546	ASR	AFFIRM SIR HIGH VIBRATION IN ENGINE PROBABLY WE MIGHT HAVE REVERTED SIR WE DON'T KNOW WE HAVE TO CHECK AFTER LANDING
0600:26	ASR	G0W546	JUST FOR INFORMATION OUR CISF PERSONNEL WHICH IS … WHICH ARE DEPLOYED AT THE END OF THE RUNWAY 02 THEY SAW SOME THAT PARTS TO BE FALLEN DOWN WHILE TAKING OFF FOR THE LAST DEPARTURE I ASSUME THAT YOU THAT YOU ARE PROBABLY THE LAST DEPARTURE FROM RUNWAY 02
0600:45	G0W546	ASR	SIR WE WILL HAVE TO DIAGNOSE ON THE GROUND ONLY SIR WE CANNOT (UNREADABLE) RIGHT NOW

Two-way communication between the aircraft and the ATC was maintained throughout the flight.

1.10 AERODROME INFORMATION

Lokpriya Gopinath Bordoloi Airport, also known as Guwahati Airport and formerly as 'Borjhar Airport', is the primary airport for the North-Eastern states of India. It is being operated &managed by Airport Authority of India.

The IATA Location Identifier Code is GAU and ICAO Location Indicator Code is VEGT. The airport co-ordinates are 26°06'22"N,91°35'09" E. Airport Elevation is 162 ft (49.37m). The details of runway distances are given below:

Runway	TORA(m)	TODA (m)	ASDA (m)	LDA (m)	RESA
02	3103	3103	3103	3103	240mX 140m
20	3103	3103	3103	3103	90m X90m

Category 7 Rescue and Fire Fighting Services is available at Guwahati Airport.

1.11 FLIGHT RECORDERS

Both Solid State Cockpit Voice Recorder (SSCVR) and Solid-State Flight Data Recorder (SSFDR) were downloaded, and readout was carried out. Relevant data was used for analysis. Sequence of some relevant events recorded in the DFDR is given below:-

a) At 05:46:30 UTC, aircraft took off from Guwahati airport.

b) At 05:47:12UTC, engine #1 N1 vibration was at 10 units, N2 vibration was at 3.7 units and EGT was at 877℃.

c) At 05:47:13 UTC, engine # 1 N1 vibration was at 10 units, N2 vibration was at 10 units and EGT was at 892℃.

d) At 05:47:21UTC, crew brought the TLA of engine # 1 gradually to IDLE position, engine # 1 N1 vibration was at 10 units, N2 vibration was at 10 units and EGT was at 1011℃.

e) At 05:52:12 UTC, Crew put the engine # 1 Master Switch OFF, N1 vibration was at 10 units, N2 vibration was at 7.9 units and EGT was at 581℃.

f) At 06:06:53 UTC, aircraft touched down at Guwahati airport.

1.12 WRECKAGE AND IMPACT INFORMATION

The damages were confined to engine # 1 only.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

The crew had undergone pre-flight medical (Breath Analyzer Test) at Guwahati before departure as per requirement of CAR Section 5, Series F, Part III. The test result was satisfactory.

1.14 FIRE

There was no fire.

1.15 SURVIVAL ASPECTS

The Incident was survivable.

1.16 TESTS AND RESEARCH

1.16.1 TEAR DOWN INSPECTION OF ENGINE

The damaged LH engine was replaced with a serviceable engine. The damaged engine was sent to OEM after the incident. The engine was inducted in OEM's facility and, Engine Disassembly and Inspection was carried out. As there were several similar occurrences involving the failure of LPT 3rd stage blades preceding this incident, no Technical Investigation was carried out by the OEM on the engine ESN P770398. The LPT 3rd stage blade failure was considered to be a known issue, which had a developed corrective action in place.

Engine ESN 770398 was inducted into the shop for stall and high vibration issues. The LPT Stage 3 was found with several broken blades. The discs and blades of LPT Stage 1 and 2, along with the 2nd stage support and 3rd stage vanes were replaced due to wear / damage. The Low Turbine module had the LPT 3 blades, shrouds, and disc replaced as per SB 72- 00-0111 in accordance with the work scope requirements. HPC IBRs were replaced to combat vibration issues and all HPC seals were repaired to address stalling problems. The Diffuser Case Group had the combustion chamber and additional parts replaced / modified to a block D configuration. The High Turbine Case Module was upgraded to a block D configuration and had the T1 and T2 blades replaced. All unserviceable parts were repaired or replaced as per EM specifications. The engine was tested as per IAW Test # 9 and passed successfully.

1.17 ORGANISATIONAL AND MANAGEMENT INFORMATION

The aircraft was operated by a scheduled operator holding AOP No. S-18 in Passenger and Cargo Category which is valid till 27.10.2022 M/s Go airlines (India) Ltd. currently have seven A320-214 and fifty A320-271N (NEO), with a total of 51aircraft.

The operator carries out its own maintenance as a CAR 145 approved organization. The year wise induction of NEO fleet (Graphical Representation) by M/s Go Airlines (India) is shown below: -

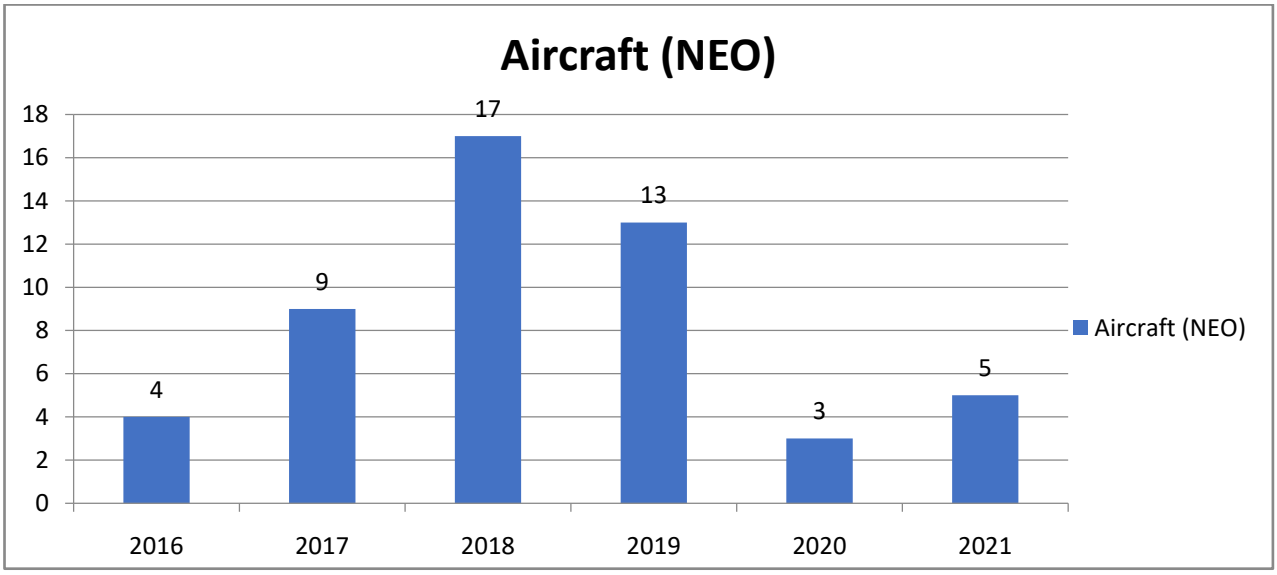

Figure 5: Yearwise induction of NEO fleet

1.18 ADDITIONAL INFORMATION

1.18.1 SIMILAR OCCURRENCES INVOLVING PW1127G-JM ENGINES

Since the induction of PW1100G-JM engines in India in the year 2016, there have been several snags reported on aircraft fitted with these engines. Most of the snags were repetitive in nature. In order to prevent reoccurrence of such failures, Pratt & Whitney came up with some rectification actions/modifications for each snag.

S. No.	Typical Snag Reported	Rectification Action proposed by P&W	Action Taken by M/s GoAir (As of Dec 2020)
1.	Number 3 bearing seal failure	Issued SB 72-00-087	All the Serviceable engines in GOW fleet are complied with SB 72-00-0087
2.	Combustor failure	IssuedSB72-00-0136	All the Serviceable engines in GOW fleet are complied with SB 72-00-0136
3.	Low Pressure Turbine failure	Issued SB 72-00-0111	All the Serviceable engines in GOW fleet are complied with SB 72-00-0111

4.	N2 Vibration	SB72-00138 was released to replace HPC stage 6 ring seal with modified one.	42 engines in GOW fleet are complied with SB 72-00-0138
5.	MGB IDG/LSOP gear failure.	Issued SB 72-00-0129	All the Serviceable engines in GOW fleet are complied with SB 72-00-0129

Table: Typical Engine Failures and Rectification Action by Pratt & Whitney.

The typical engine failures discussed in above para led to significant occurrences like In-Flight Shut Down (IFSD), Air Turn Back (ATB), Ground Turn Back (GTB), Rejected Take-Off (RTO), etc. The type and number of occurrences (Involving Indigo & Go Air aircraft) corresponding to each of the typical engine failures are listed below: -

Type of Failure → **Type of Event ↓**	**Number 3 bearing seal failure**	**Combustor failure**	**LPT failure**	**N2 Vibration**	**MGB IDG/LSOP gear failure.**
RTO (Rejected Take-off)	Nil	1	Nil	2	Nil
Engine Stall	Nil	Nil	1	Nil	Nil
ATB (Air Turn Back)	Nil	1	18	5	3
GTB (Ground Turn Back)	Nil	Nil	Nil	1	Nil
Diversion	Nil	Nil	6	1	1
Diversion/ATB	Nil	Nil	Nil	Nil	Nil
Emergency Landing	1	Nil	Nil	Nil	Nil

Table: Type of Occurrences corresponding to each engine failure.

Out of the significant occurrences mentioned in the table above, 18 occurrences were classified as serious incidents by AAIB and Annex 13 investigation were instituted to investigate these serious incidents. Further distribution of these 18 serious incidents corresponding to type of failure is as below: -

Type of Failure	**Number of Serious Incidents**
Number 3 bearing seal failure	01
LPT failure	15
N2 Vibration	01
MGB IDG/LSOP gear failure.	01

Table: Number of serious incidents corresponding to type of failures.

As per the above table, it can be seen that majority of these serious incidents corresponds to LPT failure wherein the blades of 3rd Stage of LPT failed in flight. All engines

involved in the 18 serious incidents discussed above were quarantined after the occurrence and sent to OEM (Pratt & Whitney) facility in USA and Germany for repair. Pratt and Whitney did not subject any of these engines to any technical investigation as the events were similar to various prior occurrences and considered to be a known issue. The Shop Visit report of Engine was shared with AAIB through Accredited Representative of NTSB.

Fractured blades from three engines from three random aircraft involved in 15 incidents where LPT 3rd stage blade failures occurred were sent to National Aerospace Laboratories (NAL), Bengaluru to carry out Failure Analysis on these blades. NAL carried out failure analysis of these blades and submitted its report to AAIB.

VT-WGL was fitted with ESN P770398at the time of incident. Given the similar nature of failure and findings of shop inspection, it is presumed that failure on ESN P770398was similar to failure on three engines involved in other LPT 3rd stage turbine failure incidents for which failure analysis was carried out at NAL, Bengaluru.

Following are the salient observations made in the failure analysis report provided by NAL, Bengaluru: -

- Examination revealed that all 78 LPT 3rd stage blades had fractured in the airfoil at varying heights from the blade root platform.
- Impact damages were found present predominantly along trailing edge (TE) of the available part of the airfoil.
- Fracture surfaces of the blades showed a flat appearance with vaguely delineated chevron marks emanating from the crack origins in many occasions.
- Fractography study confirmed that LPT 3rd stage blades had fractured instantaneously in a brittle manner. None of the blades showed presence of any signatures of progressive failure such as fatigue.
- Scanning electron fractography study confirmed that the crack propagation in the blades was by mixed mode of cleavage and interlamellar separation. In the fractured blades, the fracture process in gamma-phase was by cleavage while it was by interlamellar separation in lamellar colonies.
- Metallurgical evaluation of the Material of Construction (MoC) showed that stage 3 LPT blades were made of a Gamma base Titanium Aluminide (Ti-Al), an intermetallic material. The MoC of the blades has the nominal composition of 52% Titanium

(Ti), 43% Aluminium (Al), 4% Niobium (Nb) and 1% Molybdenum (Mo). The material did not have any metallurgical abnormalities that could be responsible for failure of the LPT blades.

- Ti-Albase intermetallic materials are, in general, brittle in nature having low fracture toughness. Although, the alloy used for stage III LPT blades is an improved version of Ti-Al alloys with engineered microstructure, the material still lacks adequate damage tolerance properties compared to the conventional Nickel (Ni)base super alloy that is generally used in this section of gas turbine engines.

- The MoC possessed a duplex microstructure consisting of mostly colonies of lamellae and isolated single phase gamma grains.

- Fatigue test conducted in this laboratory on the MoC of LPT 3rd stage blades showed that the material does not have enough crack growth resistance and after initiation, the crack propagates instantaneously leading to fracture.

1.18.2 SERVICE BULLETIN 72-00-0111

Service Bulletin (SB) on *"Engine - Disk, LPT 3rd Stage and Blade, LPT 3rd Stage and Shroud-Segment, Ring, 3rd Stage - Introduction of a New LPT 3rd Stage Blade which is more resistant to Impact Damage"*. The SB was initially issued on 14th May 2019, thereafter, Issue 2 was issued on 18th October 2019 and finally, Issue 3 was issued on 28th May 2020.

The reason for issue of this SB was given as *"LPT 3rd stage blades fractured in service due to impact damage"*. The cause of failure was given as *"The LPT 3rd stage blade material is sensitive to impact damage."* The solution to this failure was given as *"Introduction of a new LPT 3rd stage blade made of a different material which is more resistant to impact damage."*

The SB required that the LPT 3rd stage disk, blades, locking plates, and shroud segments be replaced by the new set made of different material.

1.18.3 GUIDELINES/DEADLINE ISSUED & ACTION TAKEN BY DGCA.

Taking cognizance of repeated failures of PW1127G-JM engines, DGCA issued a deadline to operators stating that, each A320 NEO aircraft with PW1127G-JM engine (where both engines of which has done more than 2900 FH) must have at least one LPT modified engine installed forthwith. Further, it stated that, all the A320 NEO aircraft fitted

with Pratt and Whitney engines must have LPT modified for both its engines by 31st January 2020.

On 25th November 2019, DGCA issued an order stating that the new aircraft which has been inducted will slip into the role of one existing aircraft with unmodified (LPT) engines. It was also stated that no leased engines without modified LPT 3rd stage shall be imported. Thereafter, DGCA on 19th December 2019 issued an order stating that the order dated 25th November 2019 and 16th December 2019 will be kept in abeyance to the extent of grounding an existing aircraft with both unmodified engines upon induction of new aircraft in the fleet. However, it said all other advisories issued by DGCA regarding the same will continue to remain in force.

DGCA issued order dated 13th January 2020 in which they extended the deadline of replacement of un-modified engines with modified engines to 31st May 2020. Later on, 27th May 2020, DGCA issued yet another order wherein the deadline was further extended to 31st August 2020 keeping in view of the COVID19 pandemic.

M/s Go Airlines (India) Ltd complied with SB 72-00-0111 i.e., all its NEO fleet were installed with LPT modified engines by 31st Aug 2020.

1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES

Nil

2. ANALYSIS

2.1 GENERAL

a) Both pilots were appropriately licensed and qualified to operate the flight.

b) The aircraft had a valid Certificate of Airworthiness at the time of incident. The Aircraft held a valid Certificate of Release to Service which was issued at the airport of departure. Airworthiness Directives & Service Bulletins were complied with. Transit Inspections were carried out as per the approved Transit Inspection Schedules and all higher Inspection Schedules including checks/inspection as per the manufacturer's guidelines and specified in Maintenance Programme.

2.2 CIRCUMSTANCES LEADING TO THE INCIDENT

VT-WGL was equipped with PW1127G-JM ESN P770398. This engine was fitted with pre-modified LPT 3rd stage blades which had less crack growth resistance and impact tolerance. The aircraft suffered LPT 3rd stage blade failure immediately after take-off, while climbing passing 1500ft, a loud bang was heard by the crew. Subsequently, “Engine Stall” followed by “High Engine Vibration” warnings were triggered on ECAM. The crew followed ECAM actions and QRH checklist/procedures for High Engine Vibration.

Cabin crew informed the crew about the tail pipe fire seen by them and some passengers. Precautionary engine # 1 shutdown was carried out by the Crew and ATC was informed about the Air Turn Back at 0550 UTC. After obtaining necessary clearance from ATC, Guwahati, the aircraft landed safely with single engine at Guwahati at 0607 UTC. During post flight inspection while carrying out visual inspection of the involved engine, LPT 3rd stage blades were found damaged.

Incident was one amongst series of similar events and hence Pratt and Whitney did not carry out Technical Investigation into this case.

3. CONCLUSION

3.1 FINDINGS

1. The aircraft had valid Certificate of Airworthiness, Certificate of Registration and the Certificate of Flight Release before operating the incident flight.

2. Both pilots were appropriately qualified to operate the flight.

3. There was no fire and no injury to any occupant on board the aircraft.

4. During post flight inspection, while carrying out visual inspection of the involved engine, i.e. inlet area and exhaust area of engine # 1, Low Pressure Turbine 3rd stage blades were found damaged.

5. The incident was similar to series of other events where LPT 3rd stage blades failed during operation. The failure was considered to be a known issue by the OEM andno Technical Investigation was carried out by the OEM.

6. Pratt & Whitney has issued SB 72-00-0111 to Introduce of a new LPT 3rd stage blade made of a different material which is more resistant to impact damage. The airline has subsequently incorporated the said SB in all its affected aircraft.

3.2 PROBABLE CAUSE OF THE INCIDENT

The incident was caused by failure of LPT 3rd stage blades in flight as the blade material lacked crack growth resistance and damage tolerance to withstand any impact from material that may have liberated upstream.

4. SAFETY RECOMMENDATIONS

In view of corrective action initiated by the OEM to introduce new blades with better impact resistance and subsequent compliance by the Airline no recommendation is made.

Dated: 30.12.2021

Sd/-
Jasbir Singh Larhga
Investigator-In-Charge

Sd/-
Amit Kumar
Investigator