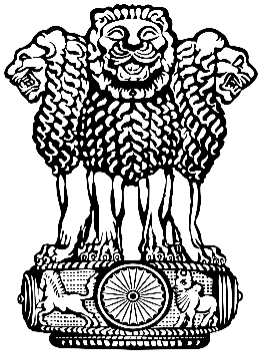

FINAL INVESTIGATION REPORT

ON

SERIOUS INCIDENT INVOLVING M/S GO AIRLINES (INDIA) LTD.

AIRBUS A320(NEO) AIRCRAFT VT-WGC

ON 07TH January 2020.

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/serious incident shall be the prevention of accidents and incidents and not to apportion blame or liability. The investigation conducted in accordance with the provisions of the 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.

INDEX

GLOSSARY	
AAIB	Aircraft Accident Investigation Bureau
AD	Airworthiness Directives
ALC	Annual Line Check
AOP	Air Operator Permit
ARC	Aircraft Review Certificate
ASDA	Accelerate Stop Distance Available
ATB	Air Turn Back
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
BECMG	Becoming
BKN	Broken
CAR	Civil Aviation Requirement
CEO	Current Engine Option
C.G	Centre of Gravity
CPL	Commercial Pilot License
CSN	Cycle Since New
DFDR	Digital Flight Data Recorder
DGCA	Directorate General of Civil Aviation
DIAL	Delhi International Airport Limited
ECAM	Electronic Centralized Aircraft Monitor
EGT	Exhaust Gas Temperature
ESN	Engine Serial Number
FL	Flight Level
FRTOL	Flight Radio Telephony Operator's Licence
FH	Flight Hours
FT	Feet
GTB	Ground Turn Back
Hrs	Hours
HPC	High Pressure Compressor
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IDG	Integrated Drive Generator
IFSD	In-Flight Shut Down
IR/PPC	Instrument Rating / Pilot Proficiency Check
kt	Knot
LDA	Landing Distance Available
LH	Left Hand
LPT	Low Pressure Turbine
LSOP	Lube & Scavenge Oil Pump
m	meter
MCT	Maximum continuous Thrust
MET	Meteorological
MGB	Main Gear Box
MoC	Material of Construction
NAL	National Aerospace Laboratories
NEO	New Engine Option
No SIG	No Significant
NTSB	National Transport Safety Board (USA)
OEM	Original Equipment Manufacturer
PF	Pilot Flying

PM	Pilot Monitoring
P&W	Pratt & Whitney
QRH	Quick Reference handbook
RESA	Runway End Safety Area
RH	Right Hand
RTO	Rejected Take-Off
RTR	Radio Telephony Restricted
SB	Service bulletin
SCT	Scattered
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid-State Flight Data Recorder
TE	Trailing Edge
TLA	Throttle Lever Angle
TSN	Time Since New
TODA	Take-off Distance Available
TORA	Take-off Run Available
UTC	Coordinated Universal Time

FINAL INVESTIGATION REPORT ON SERIOUS INCIDENT INVOLVING AIRBUS A320 (NEO) AIRCRAFT VT-WGC OPERATED BY M/S GO AIRLINES (INDIA) LTD ON 7TH JAN 2020			
1.	Aircraft	Type	Airbus A320(NEO)
		Nationality	Indian
		Registration	VT-WGC
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		48
6.	Date & Time of Serious Incident		7th Jan 2020 at 1345 UTC
7.	Place of Serious Incident		Delhi Airport
8.	Co-ordinates of Serious Incident Site.		Lat: 28° 34' 07" N Long: 77° 06' 44" E
9.	Last point of Departure		Delhi Airport
10.	Intended landing place		Varanasi Airport
11.	Type of Operation		Scheduled Operation
12.	Phase of operation		Climb
13.	Type of Serious Incident		System/Components Failure or Malfunction (Powerplant) (SCF-PP)

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

SYNOPSIS

On 07th January 2020, Airbus A320 aircraft VT-WGC operated by M/s Go Air carried out an air turn back due to high engine vibration followed by commanded In Flight Shut Down (IFSD) while operating a scheduled flight from Delhi to Varanasi. Aircraft landed safely at Delhi.

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 48 passengers on board the aircraft along with 06 crew members.

The aircraft took-off from Delhi airport and had an uneventful flight until climb phase at FL340. While passing FL340, “Engine Stall” followed by “High Engine Vibration” warning triggered on ECAM. The crew carried out the ECAM and QRH procedures and engine# 2 was shut down. All parameters for engine#1 were normal.

The crew decided to return to Delhi. Single engine landing was carried out at Delhi. The aircraft landed safely. On visual inspection from the rear side of the engine, almost all Low-Pressure Turbine (LPT) blades were found broken.

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 circumstances of this serious incident, vide Order No. INV.12011/1/2020-AAIB dated 8th Jan 2020 under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017.

1 FACTUAL INFORMATION

1.1 HISTORY OF THE FLIGHT

On 07th Jan 2020, M/s Go Air Airbus A320 (NEO) aircraft VT-WGC was scheduled to operate flight G8-186 from Delhi toVaranasi. There was no abnormality reported on the aircraft during any previous flight of the day. The aircraft was scheduled to depart from Delhi at 12:10 UTC and arrive in Varanasi at 13:55 UTC.

There were 48 passengers on board and flight was operated by 02 cockpit crew and 04 cabincrew. The aircraft took-off from Delhi at around 13:23 UTC.Immediately after take-off, while climbing passing FL340, “Engine Stall” followed by “High Engine Vibration” warning triggered on ECAM. At 13:36:41 UTC, N1 and N2 vibration for engine # 2 was 10 units and 8.3 units respectively with EGT at 941℃. The crew followed ECAM actions and QRH checklist/procedures for High Engine Vibration. All parameters for engine#1 were normal.

The engine#2 power was gradually brought back to IDLE at 13:36:48 UTC. The N1 and N2 vibration was 10 units and 7.7 respectively at that time with EGT at 970 ℃. Subsequently, engine # 1 power was changed from CLIMB to FLX-MCT. Engine # 2 parameters i.e., N1 vibration continued to remain at about 10 units. Hence, the crew decided to return to Delhi. Crew declared “PAN PAN”and informed theDelhi ATC accordingly about their decision, at 13:37:49 UTC. Since the engine#2, N1 and N2 vibration continued to remain at higher side, crew carried out precautionary shut down of engine#2 at 13:39:09 UTC.

After obtaining necessary clearance from Delhi ATC, the aircraft landed safely at Delhi on Runway 28 at 14:06 UTC.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	48	

1.3 DAMAGE TO AIRCRAFT

The aircraft damages due to the incident were limited to its starboard engine. The LPT 3rd Stage blades of starboard engine were found broken during inspection. The images of damaged blades taken from rear view are shown below.

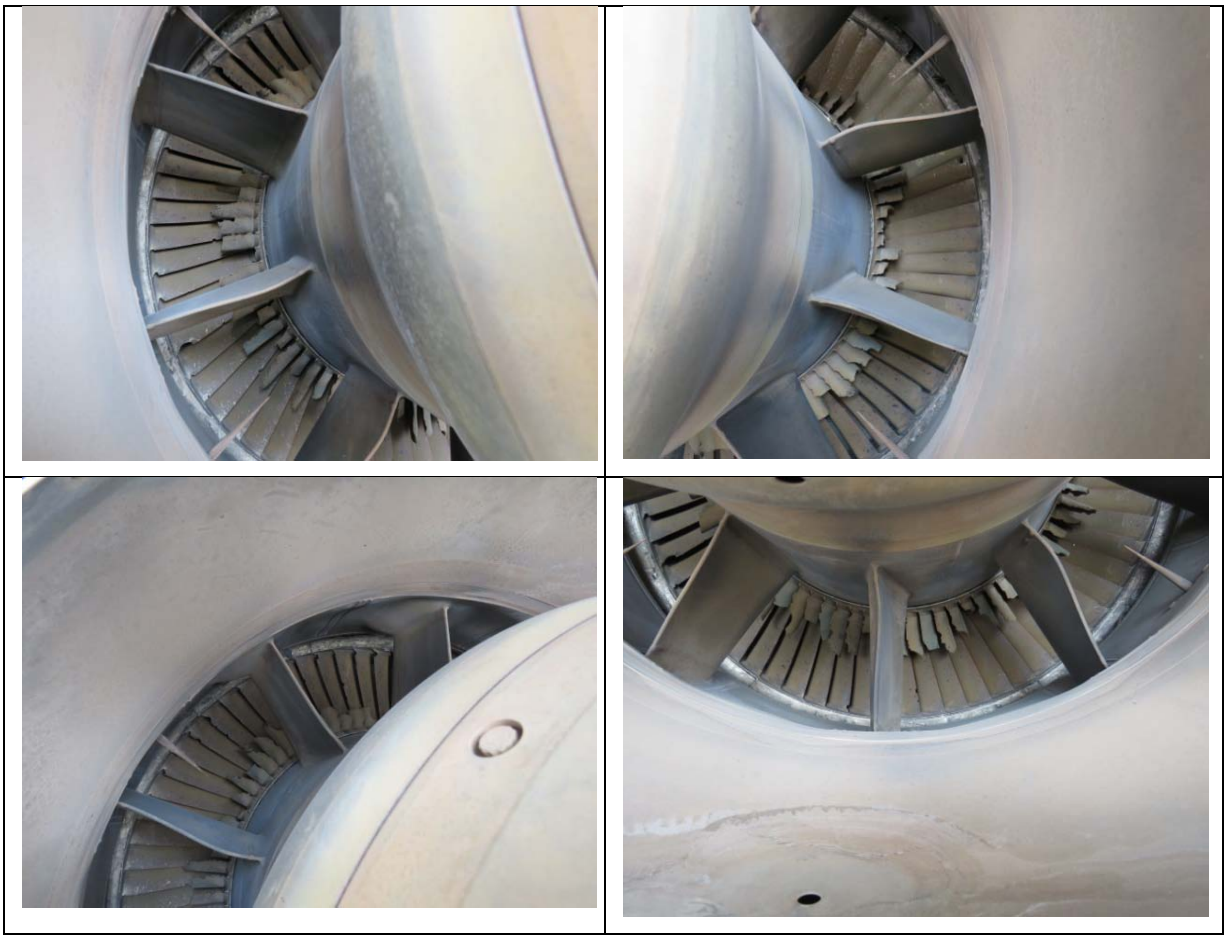

Figure 1: Engine LPT 3rd Stage blades were found damaged during inspection.

1.4 OTHER DAMAGE

Nil

1.5 PERSONNEL INFORMATION

1.5.1 Pilot – In – Command

Nationality	Indian
Age	52years
LicenseCategory	ATPL
Date of issue	18-Aug-2010
Valid Up to	17-Aug-2021
Validity of Medical	28-Jun-2020

FRTOL Date of issue/Validity	23-Aug-1991 / 21-Oct-2021
RTR Date of issue/Validity	28-Sep-2009 / 28-Aug-2032
Total Flying Experience	10597Hrs
Hours Flown on Type	1731 Hrs
Hours of flying at the time of incident	10597Hrs
Hours flown in last 365 days	133:24 Hrs
Hours flown in last 180 days	133:24 Hrs
Hours flown in last 30 days	59:29 Hrs
Hours flown in last 7 days	17:18 Hrs
Hours flown in last 24 Hrs.	06:56 Hrs
Rest period before the flight	39 Hrs
Last IR/ PPC	25-Oct-2019
Last Annual Line Check (ALC)	05-Dec-2019
Last Ground Refresher	30-Sep-2019

1.5.2 Co-Pilot

Nationality	Indian
Age	37 years
License Category	CPL
Date of issue	15-Nov-2014
Valid Up to	14-Nov-2024
Medical Validity	18-Jun-2020
FRTOL Date of issue/Validity	15-Nov-2014 / 14-Nov-2024
RTR Date of issue/Validity	14-Sep-2010 / 14-Sep-2062
Total Flying Experience	452:15 Hrs
Hours Flown on Type	237 Hrs
Hours of flying at the time of incident	452:15 Hrs
Hours flown in last 365 days	182:24 Hrs
Hours flown in last 180 days	182:24 Hrs
Hours flown in last 30 days	72:11 Hrs
Hours flown in last 7 days	14:40 Hrs
Hours flown in last 24 Hrs.	04:07 Hrs
Rest period before the flight	51 Hrs
Last IR/ PPC	30-Jul-2019
Last Annual Line Check (ALC)	28-Nov-2019
Last Ground Refresher	30-Sep-2019

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.

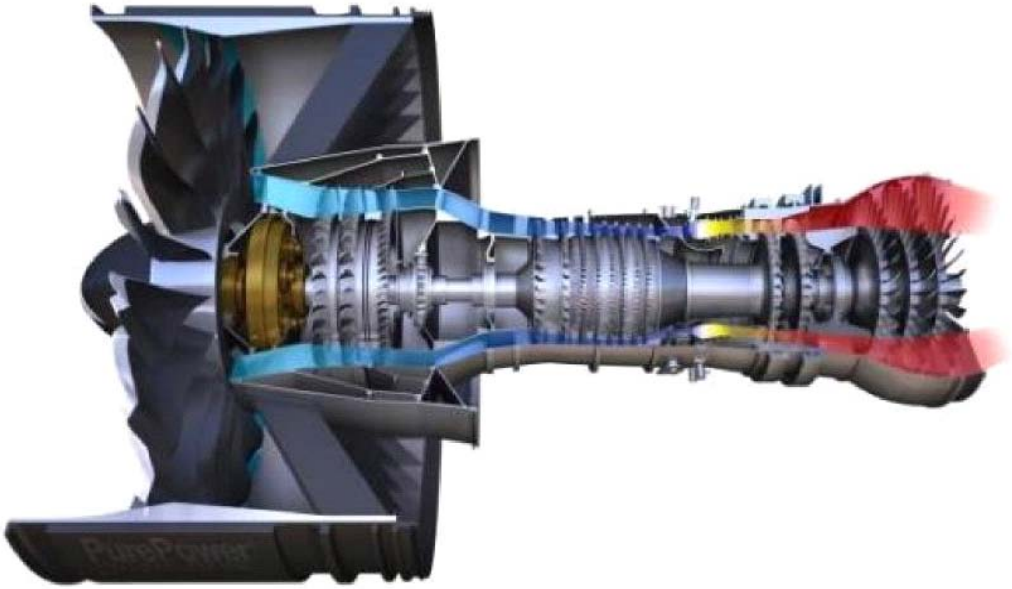

Figure 2: ENGINE CROSS SECTION

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

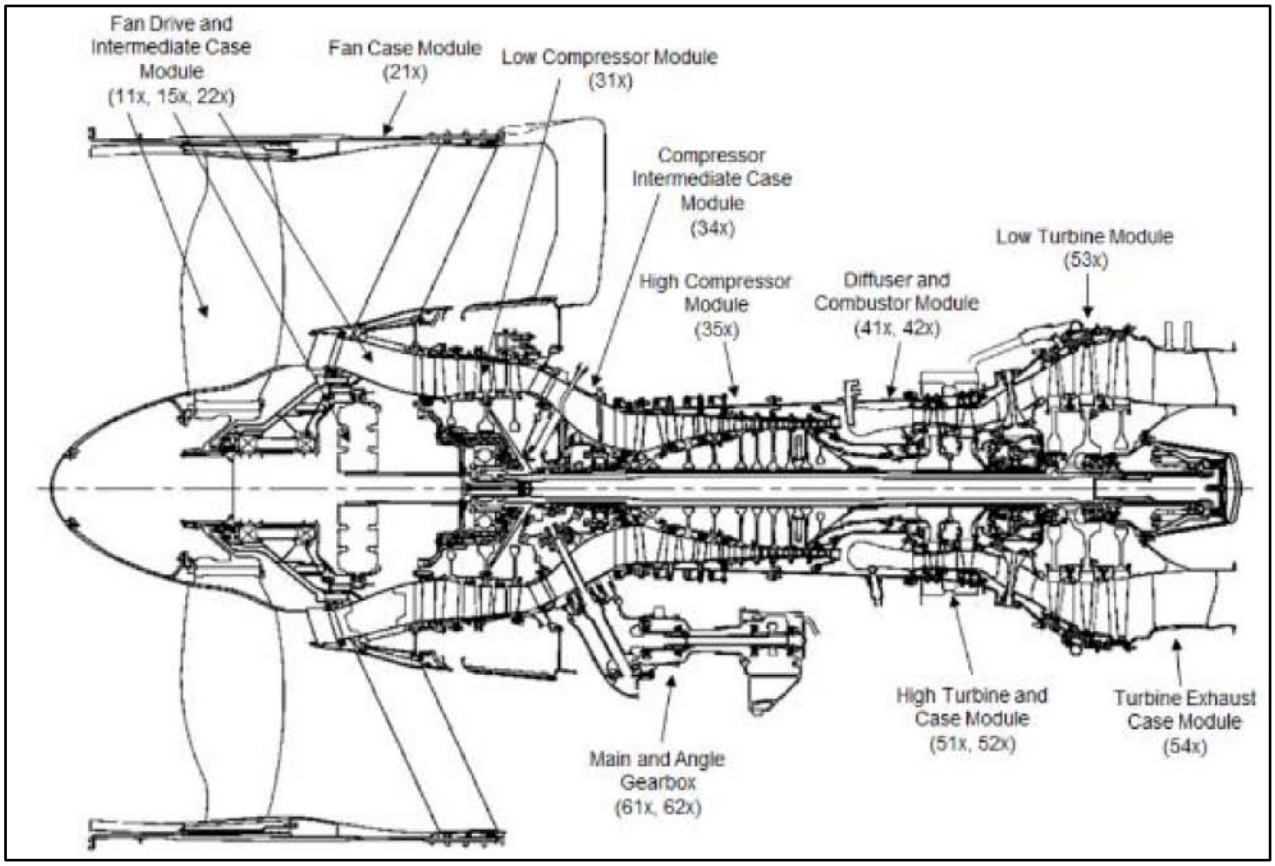

Figure 3: Engine Modules/ Build Group

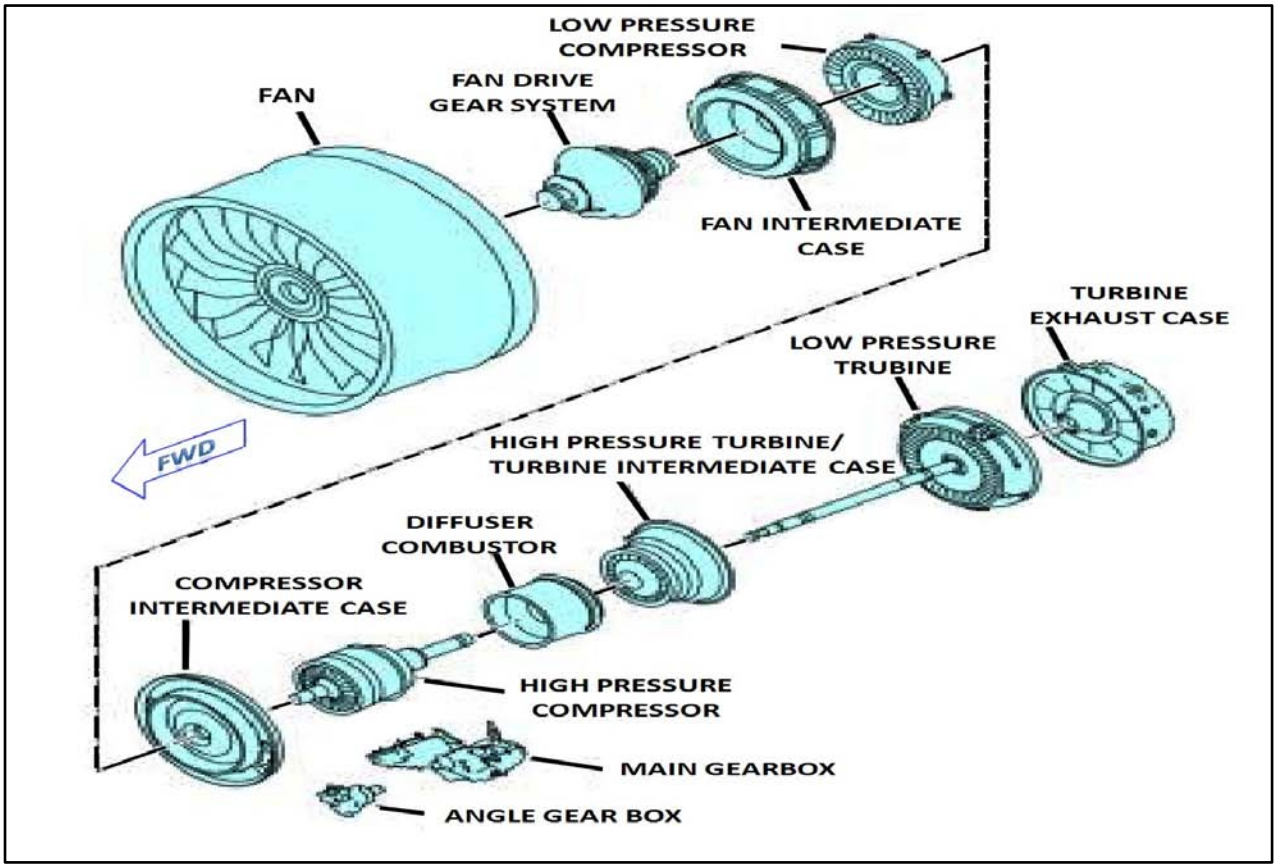

Figure 4: Engine Modules/ Build Group

1.6.3 Aircraft VT-WGC General Information

Aircraft Model	A320-271N
Aircraft S. No.	07172
Year of Manufacturer	2016
Name of Owner	Jackson Square Aviation Ireland Limited
Category	Passenger
A R C issued on	11/11/2019
ARC valid up to	11/11/2020
Aircraft Empty Weight	42529 Kg
Maximum Takeoff weight	73500 Kg
Date of Aircraft weighment	05/09/2019
Operating Empty Weight	43492.18 Kg
Max Usable Fuel	18622 Kg
Max Payload with full fuel	30007.82 Kg
Empty Weight C.G	42528.91
Next Weighing due	05/ 09/24
Total Aircraft Hours/Cycles	11049:44 Hrs / 7151 Cycle (as on 07/01/2020)
Last major inspection	16/11/2018
Engine Type	PW1127GA-JM
Date of Manufacture LH	27/07/2019
Engine Sl. No. LH	P771221
Last major inspection (LH)	NOT DUE
Total Engine Hours/Cycles LH	1471:56 Hrs / 779 Cycle (as on 07/01/2020)
Date of Manufacture RH	30/09/2016
Engine Sl. No. RH	P770207
Last major inspection (RH)	27/04/2019(TSN- 3659:35 Hrs, CSN- 2341)
Total Engine Hours/Cycles RH	6100:48 Hrs / 3957 Cycle (as on 07/01/2020)
Aeromobile License Validity	31/12/2022
AD, SB, Modification complied	All complied as applicable

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 – Delhi International Airport from 1300 UTC to 1430 UTC

Time in UTC	Wind Dir	Wind Speed (kt)	Vis (m)	Clouds	Temp (℃)	Dew Point	QFE hPa	QNH hPa	TREND
1300	090	06	2200	SCT 3000 FT BKN 8000 FT	16	12	987	1014	No SIG
1330	080	06	1800	SCT 3000 FT BKN 8000 FT	16	12	987	1014	No SIG
1400	080	06	1600	SCT 3000 FT BKN 10000 FT	15	13	987	1014	BECMG 1500
1430	100	08	1600	SCT 3000 FT BKN 10000 FT	15	13	988	1015	BECMG 1500

1.8 AIDS TO NAVIGATION

All Navigational Aids available at Delhi 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

At the time of incident, the aircraft was in contact with Delhi Area Control (East section) on frequency 120.9 MHz. The transcript of relevant communication is placed below.

TIME (HHMMSS)	UNIT	TRANSMISSIONS
132838-132857	GOW186	RADAR GOWAIR ONE EIGHT SIX CLIMBING LEVEL TWO THREE ZERO
	RADAR	GOWAIR ONE EIGHT SIX RADAR CLIMB TO FLIGHT LEVEL THREE FIVE ZERO REPORT LEVEL REQUESTED
	GOW186	CLIMB THREE FIVE ZERO AND ANY LEVEL UPTO THREE SEVEN ZERO SIR
	RADAR	GOWAIR ONE EIGHT SIX RADAR CLIMB TO FLIGHT LEVEL THREE SEVEN ZERO
	GOW186	CLIMB THREE SEVEN ZERO GOWAIR ONE EIGHT SIX
133749-133831	GOW186	PAN PAN PAN DELHI GOAIR ONE EIGHT SIX REQUEST DIRECT DELHI AND WE ARE COMING BACK DUE ENGINE PROBLEM
	RADAR	GOWAIR ONE EIGHT SIX DELHI AND CONFIRM ANY FURTHER ASSISTANT REQUIRED
	GOW186	AS OF NOW NOTHING SIR.
133952-134010	RADAR	GOWAIR ONE EIGHT SIX DELHI REPORT ENDURANCE
	GOW186	WE HAVE ENDURANCE OF TWO HOURS AND TWENTY

		FIVE MINUTES AS OF NOW SIR
135051-52	RADAR	REPORT NATURE OF PROBLEM
135101-05	GOW186	ENGINE NUMBER TWO PROBLEM DUE HIGH VIBRATION WE HAD TO SHUT DOWN THE ENGINE
135105-06	RADAR	ROGER HIGH VIBRATION CONFIRM
135107-10	GOW186	HIGH VIBRATION AND WE HAVE TO SHUT DOWN THE ENGINE THAT'S WHY WE ARE RETURNING BACK SIR
135921-30	RADAR	GO AIR ONE EIGHT SIX DESCEND TO TWO THOUSAND SIX HUNDRED FEET CLEARED FOR ILS APPROACH RUNWAY TWO EIGHT, FULL EMERGENCY DECLARED, FIRE TENDER MAY BE FOLLOW YOU ON RUNWAY.
135932-35	GOW186	ROGER SIR MONITORED GO AIR ONE EIGHT SIX THANKS FOR THAT
140336-41	TOWER	GO AIR ONE EIGHT SIX DELHI TOWER, ROGER RUNWAY TWO EIGHT CLEARED TO LAND WIND ZERO EIGHT ZERO DEGREES ZERO SEVEN KNOTS.
140342-44	GOW186	CLEARED TO LAND RUNWAY TWO EIGHT GO AIR ONE EIGHT SIX.

1.10 AERODROME INFORMATION

Indira Gandhi International Airport, also known as Delhi Airport is the primary airport for Indian capital city of New Delhi as well as India. It is being operated &managed by Delhi International Airport Limited (DIAL).

The IATA Location Identifier Code is DEL and ICAO Location Indicator Code is VIDP. The airport co-ordinates are 28°34'07"N,77°06'44" E. Airport Elevation is 778 ft. The details of runway distances for involved runway are given below:

Runway	TORA(m)	TODA (m)	ASDA (m)	LDA (m)	RESA
10	3813	3813	3813	3813	240mX 150m
28	3813	4087	3813	3813	240m X150m

Category 10 Rescue and Fire Fighting Services is available at Delhi 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 13:22:56 UTC, aircraft took off from Delhi airport.

b) At 13:36:41 UTC, engine #2 N1 vibration was at 10 units, N2 vibration was at 8.3 units and EGT was at 941℃.

c) At 13:36:48 UTC, crew brought the TLA of engine # 2 gradually to IDLE position and engine # 2 N1 vibration was at 10 units, N2 vibration was at 7.7 units and EGT was at 970℃.

d) At 13:36:56 UTC, engine #2 N1 vibration was at 10 units, N2 vibration was at 6.6 units and EGT was at 986℃.

e) At 13:37:25 UTC, crew moved the TLA of engine # 1 gradually to FLX-MCT position from Climb and engine # 2 N1 vibrations was at 10 units, N2 vibration was at 7.7 units and EGT was at 643 ℃.

f) At 13:39:09 UTC, Crew put the engine # 2 Master switches OFF, N1 vibration was at 5.5 units, N2 vibration was at 6.9 units and EGT was at 643℃.

g) At 14:06:02 UTC, aircraft touched down at Delhi airport.

1.12 WRECKAGE AND IMPACT INFORMATION

The damages were confined to engine # 2 only.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

The crew had undergone pre-flight medical (Breath Analyzer Test) at Delhi 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 engine was replaced with a serviceable engine. The damaged LH 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 P770207. The LPT 3rd stage blade failure was considered to be a known issue, which had a developed corrective action in place.Engine ESN P770207 was inducted into the shop for LPT 3rd Stage blades issues. All LPT 3rdStage blades were replaced with new blades and necessary repair, maintenance or part replacement was carried out on different modules of the engine affected by wear or damages consequential to the LPT 3rd stage failure.

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.

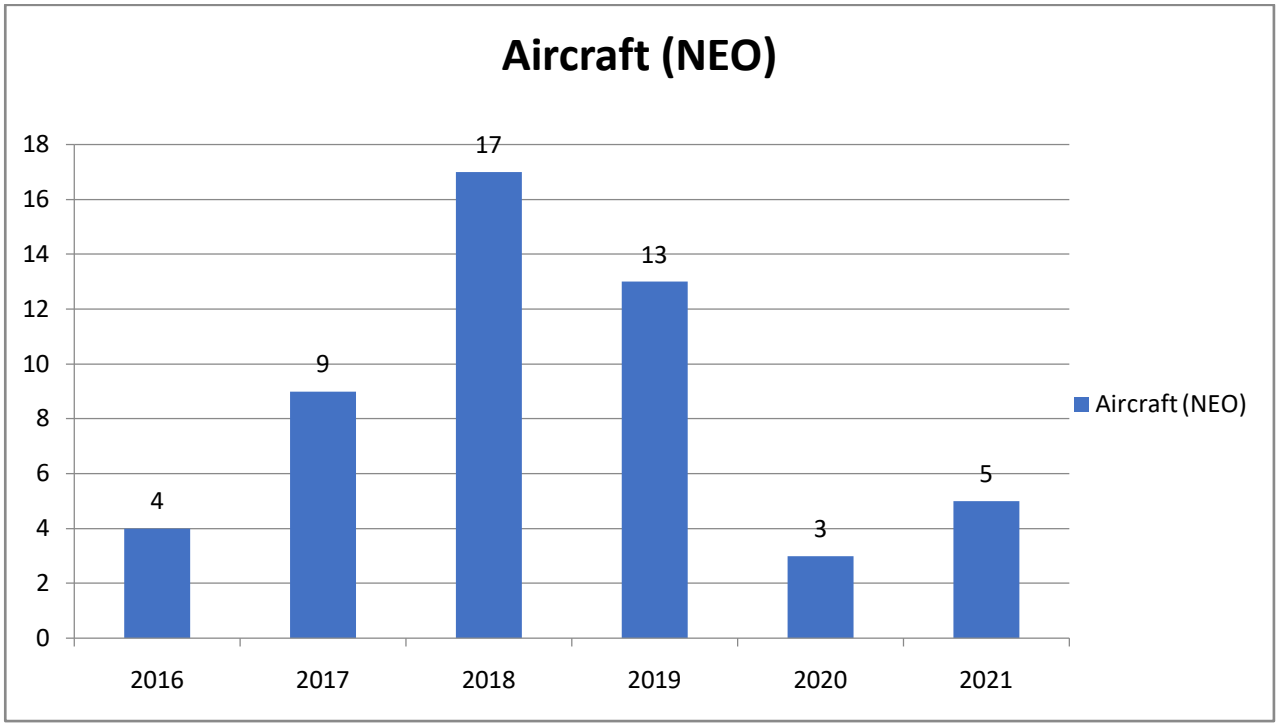

Figure 5: Yearwise induction of NEO fleet in Go Air

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-WGC was fitted with ESN P770207at the time of incident. Given the similar nature of failure and findings of shop inspection, it is presumed that failure on ESN P770207was 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 SB mentioned the cause of failure as *"The LPT 3rd stage blade material is sensitive to impact damage."*Further, a solution for 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 on 01 Nov 2019to 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 any new aircraft which has been inducted will slip into the role of one existing aircraft with unmodified (LPT) engines and one existing aircraft with unmodified engines would be grounded. 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 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.

Later, 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. And 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-WGC was equipped with PW1127GA-JM ESN P770207. 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 FL340, "Engine Stall" followed by "High Engine Vibration" warning triggered on ECAM. The crew followed ECAM actions and QRH checklist/procedures for High Engine Vibration

Crew declared "PAN PAN" and ATC was informed about the Air Turn Back at 13:37:49 UTC. Precautionary engine # 2 shutdown was carried out by the Crew at 13:39:09 UTC. After obtaining necessary clearance from ATC, Delhi, the aircraft landed safely with single engine at Delhi at 14:06 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 # 2, 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.

Jasbir Singh Larhga
Investigator In Charge

Amit Kumar
Investigator

Date: 22 June 2022
Place: New Delhi