FINAL REPORT OF SERIOUS INCIDENT INVOLVING AIRBUS A320 (NEO) AIRCRAFT VT-WJEOPERATED BY M/s GO AIRLINES (INDIA) LIMITED ON 22ND DECEMBER 2019.

Jasbir Singh Larhga
Investigator -In- charge

Amit Kumar
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/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
AOP	Air Operator Permit
ARC	Aircraft Review Certificate
ASDA	Accelerate Stop Distance
ASR	Area Surveillance Radar
ATB	Air Turn Back
ATC	Air Traffic Control
BKN	Broken
CAR	Civil Aviation Requirement
CEO	Current Engine Option
DGCA	Directorate General of Civil Aviation
EGT	Exhaust Gas Temperature
EM	Engine Manual
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
LAC	Lower Area Control
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
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid-State Flight Data Recorder
TLA	Throttle Lever Angle
TODA	Take-off Distance Available
TORA	Take-off Run Available
TWR	Tower
UTC	Coordinated Universal Time

FINAL REPORT OF SERIOUS INCIDENT INVOLVING AIRBUS A320 (NEO) AIRCRAFT VT-WJEOPERATED BY M/s GO AIRLINES (INDIA) LIMITED ON 22ND DECEMBER 2019.

1.	**Aircraft**	**Type**	**:**	Airbus A320(NEO)
		Nationality	**:**	Indian
		Registration	**:**	VT-WJE
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**		**:**	172
6.	**Date & Time of Serious Incident**		**:**	22nd December 2019 at 1233 UTC
7.	**Place of Serious Incident**		**:**	Mumbai Airport
8.	**Co-ordinates of Serious Incident Site**		**:**	Lat: 19°05'19" N Long: 74°52'05" E.
9.	**Last point of Departure**		**:**	Mumbai Airport
10.	**Intended landing place**		**:**	Chandigarh 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 22nd December 2019, Airbus A320 aircraft VT-WJEoperated by M/s Go Air carried out an air turn back due to high engine vibration while operating a scheduled flight from Mumbai to Chandigarh. Aircraft landed safely at Mumbai.

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 172 passengerson board the aircraft with 06 crew members.

The aircraft took-off from Mumbai airport and while climbing passing FL210, “Engine stall” and “High Engine Vibration” ECAM warning message triggered for Engine # 1. The crew carried out the ECAM and QRH procedures. Due to engine vibration and fluctuating parameters, the crew decided to return to Mumbai and landed safely in Mumbai at 1250 UTC. On visual inspection of 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 22nd Dec 2019, M/s Go Air Airbus A320 (NEO) aircraft VT-WJE was scheduled to operate flight G8-2506 from Mumbai to Chandigarh.There was no abnormality reported on the aircraft during any previous flight of the day. The aircraft was scheduled to depart from Mumbai at 11:35 UTCand arrive in Chandigarh at 13:55 UTC.

There were 172 passengers on board and flight was operated by 02 cockpit crew and 04 cabincrew. The aircraft took-off from Mumbai at approx.12:22UTC. After take-off, while climbing through FL210 to FL220, “Engine Stall” followed by “High Engine Vibration” warnings were triggered on ECAM for Engine # 1. At 12:30:40 UTC,N2 vibration on Engine # 1 reached max (10 units) and within second N1 vibration also reached Max vibration of 10 units. The highestrecorded EGT on the Engine # 1was 1134 ℃,at 13:31:01 UTC. The crew followed ECAM actions and QRH checklist/procedures for High Engine Vibration.

The Engine # 1 power was gradually brought back to IDLE at 12:31:11 UTC and after few secondsN1& N2 vibration and EGT dropped to within limit. Crew decided to return to Mumbai and accordinglyATC was informed by the crew at 12:31:44 UTC. Subsequently,Engine #2 power was changed from CLIMB to MCT at 12:33:08 UTC.

Between 12:34:49 UTC to 12:37 UTC, crew advanced the Engine # 1TLA gradually from 1° to 10° but N1 and N2 vibration started to increase again. Thereafter,the crew kept the Engine # 1TLA at IDLE position.

After obtaining necessary clearance from ATC, Mumbai, the aircraft landed safely at Mumbaion Runway 27 at 12:50 UTC. Overweight landing was not required.The passengers disembarked normally. There was no fire and no injury to any occupant on board the aircraft.

Post landing during visual inspection of the Engine # 1 exhaust area, all blades of Low-Pressure Turbine 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	172	___

1.3 DAMAGE TO AIRCRAFT

The aircraft damages due to the incident were limited to its left engine. The LPT 3rd Stage blades of left engine were found broken during inspection. The images of damaged blades are shown in the figure below.

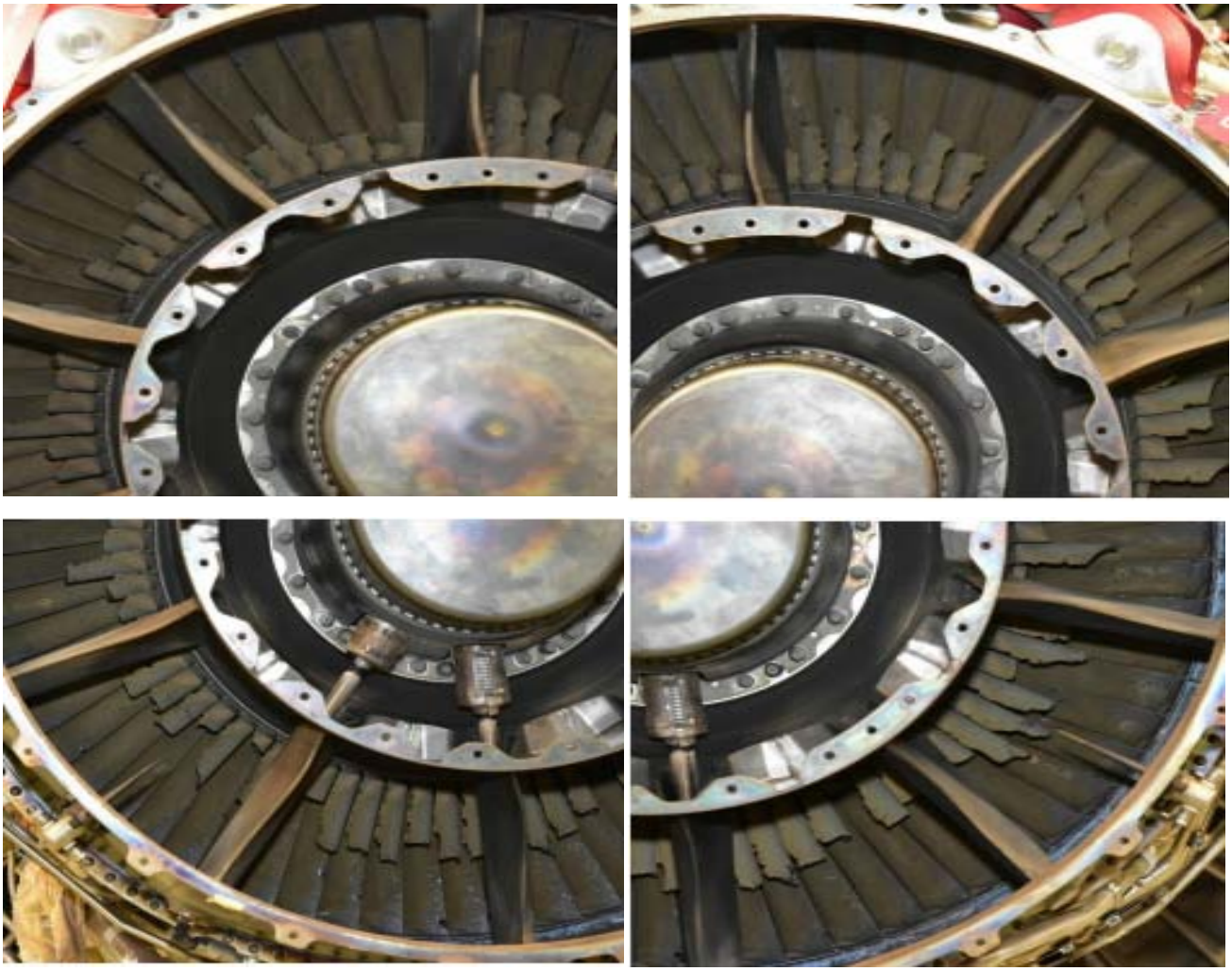

Figure 1: Engine LPT 3rd Stage blades were found damaged.

1.4 OTHER DAMAGE

Nil

1.5 PERSONNEL INFORMATION

1.5.1 PILOT – IN – COMMAND

Age	63 years
License	ATPL
Date of Issue	30 Dec 2002
Validity	29 Dec 2021
Date of Class I Med. Exam.	10 Dec 2019
Class I Medical Validity	9 Jun 2020
Date of issue FRTOL License	30 Dec 2002
FRTO License Validity	10 Sep 2021
Endorsements as PIC	24 May 2013
Total flying experience	9561:09hrs
Total flying experience on type	5650:29hrs
Last Flown on type	A320
Total flying experience during last 1 year	930:23hrs
Total flying experience during last 6 Months	563:43hrs
Total flying experience during last 30 days	69:44hrs
Total flying experience during last 07 Days	22:30hrs
Total flying experience during last 24 Hours	06:18hrs
Rest Period before Flight	15 hrs 15 min

1.5.2 CO-PILOT

Age	31 years
License	CPL
Date of Issue	13 Jul 2010
Validity	12 Jul 2020
Date of Class I Medical Exam.	28 Mar 2019
Class I Medical Validity	27 Mar 2020
Date of issue FRTOL License	13 Jul 2010
FRTO License Validity	12 Jul 2020
Endorsements on Type	2 May 2016
Total flying experience	2988:51 hrs
Total flying experience on type	2756:12hrs
Last flown on type	A 320
Total flying experience during last 1 year	717:50hrs
Total flying experience during last 6 Months	384:02hrs
Total flying experience during last 30 days	79:18hrs
Total flying experience during last 07 Days	14:38hrs
Total flying experience during last 24 Hours	NIL
Rest period before flight	43 hrs

1.6 AIRCRAFT INFORMATION

1.6.1 AIRBUS A320 (NEO) AIRCRAFT DESCRIPTION

The Airbus A320is 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_2emissions and reduction in engine noise. A320(NEO) 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 has 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.

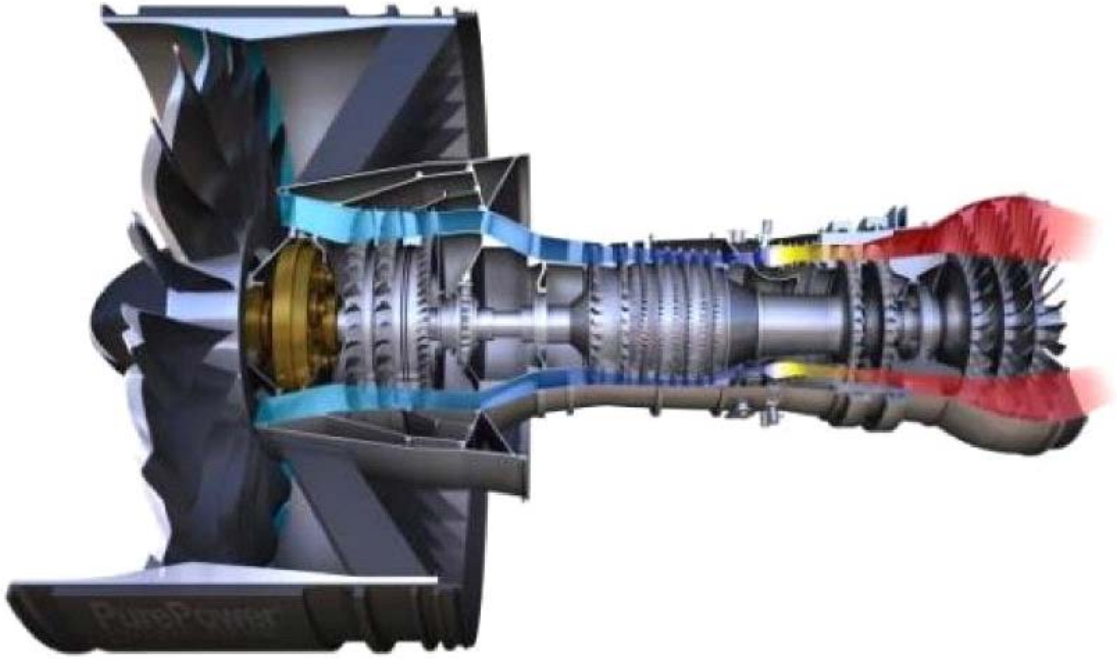

Figure 2: ENGINE CROSS SECTION

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

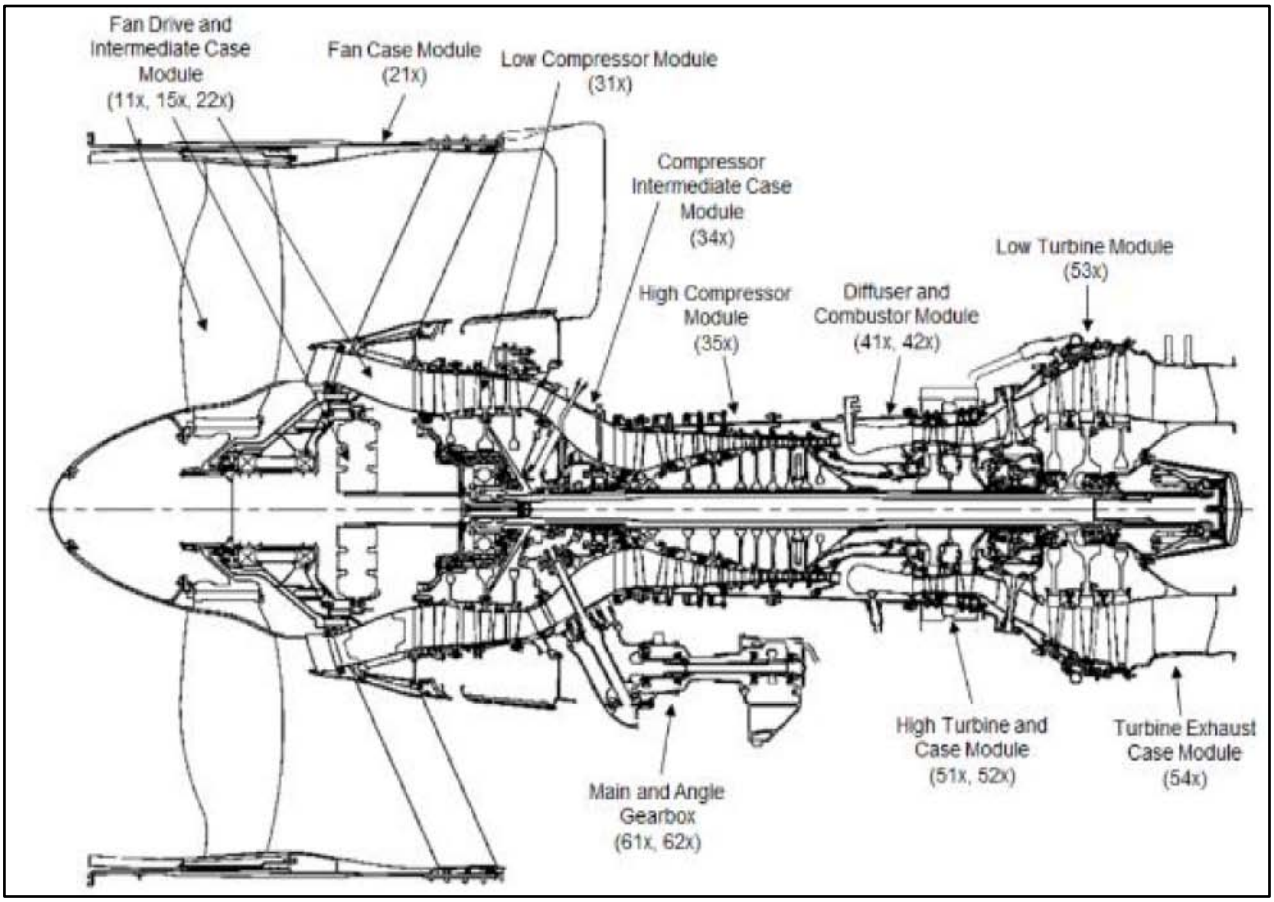

Figure 3: Engine Modules/ Build Group

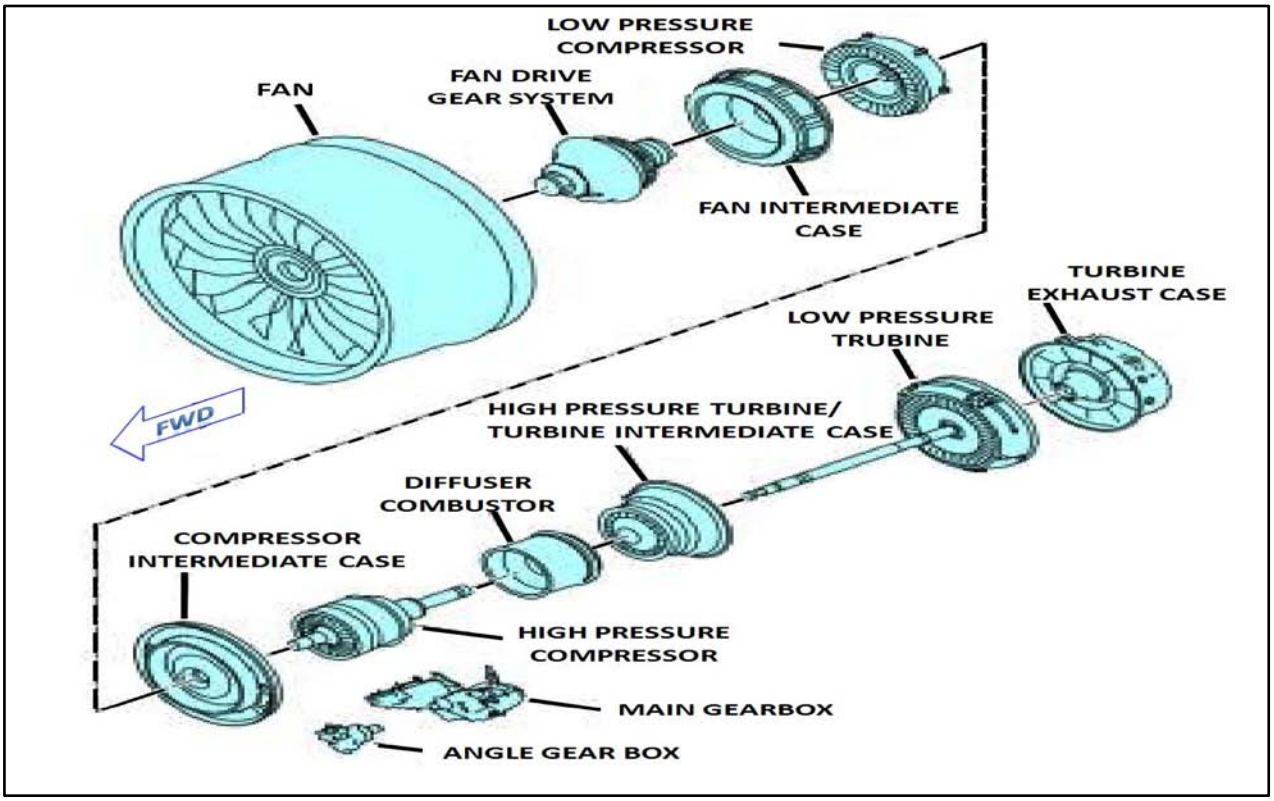

Figure 4: Engine Modules/ Build Group

1.6.3 Aircraft General Information: VT-WJE

Aircraft Model	A320-271N
Aircraft S. No.	08650
Year of Manufacturer	2018
Name of Owner	Jackson Square Aviation Ireland Ltd
C of R	5014
C of A	7117
Category	Passenger
C of A Validity	Valid
A R C issued on	27/12/2018
ARC Validity	27/12/2019
Aircraft Empty Weight	42355 kg
Maximum Takeoff weight	73500 kg
Date of Aircraft weighing	05/09/2019
Operating Empty Weight	43317 kg
Max Usable Fuel	18622 kg
Max Payload with full fuel	11560 kg
Empty Weight C.G	42436 kg
Next Weighing due	05/09/24
Total Aircraft Hours (As on26/12/2019)	3902:07 hrs / 2275 cycles
Last major inspection	A5 Checks on 24/11/2019
Engine Type	PW1127GA-JM
Date of Manufacture (LH)	18/10/2018
Engine Sl. No. (LH)	P771030
Last major inspection (LH)	A5 Checks on 24/11/2019
Total Engine Hours/Cycles (LH) (As on 26/12/2019)	3902:07 hrs / 2275 cycles
Date of Manufacture (RH)	23/07/2019
Engine Sl. No. (RH)	P771436
Last major inspection (RH)	A5 Checks on 24/11/2019
Total Engine Hours/Cycles (RH) (As on 26/12/2019)	3902:07 hrs / 2275 cycles
Aeromobile License Valid upto	29/02/2024

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

1.7 METEOROLOGICAL INFORMATION

MET Report – Mumbai Airport from 1130UTC to 1300 UTC.

Time (UTC)	Wind	Visibility (m)	Clouds	Temp (°C)	Dew Point (°C)	QFE hPa	TREND
1130	260°/07 kt	3000	BKN 1000FT	31	20	1009	No SIG
1200	250°/07 kt	2500	BKN 1000 FT	30	21	1009	No SIG
1230	280°/05kt	2500	BKN 1000FT	30	21	1010	No SIG
1300	260°/04kt	2500	BKN 0900 FT	29	22	1010	No SIG

1.8 AIDS TO NAVIGATION

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

1.9 COMMUNICATIONS

At the time of incident, the aircraft was in contact with Local Area Control, Mumbai on frequency 133.425 MHz.The transcript of relevant ATC communication is placed below.

TIME	FROM	TRANSMISSION
12:31:44	GOW2506	GOW2605 GOW2506 PAN PANPAN I HAVE A SMALL ENGINE PROBLEM WILL COME BACK TO YOU LEVELLING OUT 210
12:31:52	LAC	CONFIRM GOW2605 OR GOW2506
12:31:53	GOW2506	2506
12:31:57	GOW2506	AND LEVELLING OUT 210
12:32:10	LAC	ROGER SIR REQUEST REPORT CONFIRM YOU WOULD LIKE TO LAND MUMBAI
12:32:12	GOW2506	AFFIRM WE WILL BE LANDING AT MUMBAI AND I AM LEVELLING OUT 210 WE CAN TAKE VECTOR BACK
12:32:22	LAC	ROGER SIR ROGER SIR TURN MAINTAIN 210 AND TURN RIGHT TURN RIGHT HEADING 090
12:34:12	LAC	GOW2506 CONFIRM REQUESTING PRIORITY LANDING AT MUMBAI
12:34:13	GOW2506	AFFIRM SIR
12:34:14	LAC	ROGER PRIORITY LANDING APPROVED AND CONTINUE DESCEND LEVEL 150

12:35:01	LAC	GOW2506 CONTACT RADAR 127.9
12:38:53	ASR	CONFIRM READY FOR APPROACH
12:38:55	GOW2506	AFFIRM SIR
12:38:56	ASR	GOW2506 ROGER CONTACT ARRIVAL 119.3
12:39:00	GOW2506	119.3 GOW2506
12:39:30	ASR	GOW2506 DESCEND FL70
12:40:11	ASR	GOW2506 REPORT ENDURANCE
12:40:20	GOW2506	THREE HOURS
12:40:28	ASR	GOW2506 ANY FURTHER ASSISTANCE REQUIRED
12:40:31	GOW2506	NEGATIVE SIR WE WILL BE LANDING SECOND ENGINE ONE UNDER VIBRATION UNDER –GARBLED- WE WILL BE LANDING ON FULL EMERGENCY
12:41:06	ASR	GOW2506 DESCEND TO 3800 FEET QNH1010
12:43:21	ASR	GOW2506 NEGATIVE ATC SPEED RESTRICTION
12:45:30	ASR	GOW2506 AFFIRM NOW HEADING 230 INTERCEPT LOCALIZER RWY 27
12:45:32	GOW2506	HEADING 230 INTERCEPT LOCALIZER RWY 27 AND WE ARE 14 MILES GOW2506
12:45:39	ASR	GOW2506 DESCEND TO 2900 FEET CLEARED FOR ILS APPROACH RWY 27
12:45:44	GOW2506	DESCEND TO 2900 FEET CLEARED FOR ILS APPROACH RWY 27
12:47:21	ASR	GOW2506 CONTINUE APPROACH CONTACT TWR 118.1
12:47:48	GOW2506	CONTINUE APPROACH RWY 27 GOW2506
12:47:49	TWR	GOW2506 CLEARED TO LAND RWY 27 WIND 270/04 KNOTS
12:47:54	GOW2506	CLEARED TO LAND RWY 27 GOW2506

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

1.10 AERODROME INFORMATION

Chhatrapati Shivaji Maharaj International Airport, Mumbai (IATA: BOM, ICAO: VABB), is the primary international airport serving the Mumbai Metropolitan Area, India**.** The airport is operated by Mumbai International Airport Limited (MIAL), and Airports Authority of India (AAI) maintains Communication, Navigation and Surveillance (CNS) & Air Traffic Management (ATM) services at the airport.

The IATA Location Identifier Code is BOM and ICAO Location Indicator Code is VABB.Airport Co-ordinates are Lat: 19°05'19" N, Long: 74°52'05" E. Airport Elevation is37 feet (11.27meters). The details of runway distances are given below:

Runway	TORA(m)	TODA (m)	ASDA (m)	LDA (m)	RESA
09	3187	3187	3187	3045	240m X 100 m
27	3448	3448	3448	2965	240m X 100 m

Category '10'Rescue and Fire Fighting Services is available at Mumbai 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.

Parameters recorded inDFDR:

a) At 12:22:37 UTC, aircraft took off from Mumbai airport.

b) At 12:30:40 UTC, engine # 1N1 vibration was at 1.2 units, N2 vibration was at 10 units and EGT was at 913 ℃.

c) At 12:30:41 UTC, engine # 1N1vibration was at10 units, N2 vibration was at 10 units and EGT was at 937 ℃.

d) At 12:31:01 UTC, engine # 1N1 vibration was at 10 units, N2vibration was at 10 units and EGT was at 1134 ℃.

e) At 12:31:11 UTC, Crew gradually brought the TLA of engine # 1 to IDLE, N1 vibration was at 10 units, N2vibration was at 10 units and EGT was at 996 ℃.

f) At 12:31:23 UTC, TLA of engine # 1was at IDLE, N1 vibration was at7.9 units, N2 vibration was at 10 units and EGT was at 845 ℃.

g) At 12:31:31 UTC, TLA of engine # 1was at IDLE, N1 vibration was at 0.6 units, N2vibration was at 5.6 units and EGT was at 653 ℃.

h) At 12:33:08 UTC, Crew gradually brought the TLA of engine # 2 to MCT from IDLE.

i) At 12:34:49 UTC, Crew advances the TLA of at 1°, N1 vibration was at 0.2 units, N2 vibration was at 2.9 units and EGT was at 537℃.

j) At 12:36:33 UTC, Crew advances the TLA of engine # 1at 8°, N1 vibration was at 9.8 units, N2 vibration was at 5 units and EGT was at 515℃.

k) At 12:37:02 UTC, Crew advances the TLA of engine # 1at 10°, N1 vibration was at 1 unit, N2 vibration was at 3.7units and EGT was at 523℃.

l) At 12:50:46 UTC, aircraft touched down at Mumbai airport.

1.12 WRECKAGE AND IMPACT INFORMATION

The damages were confined toengine # 1only.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

The crew had undergone pre-flight medical (Breath Analyzer Test) at Mumbai 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 P771030. The LPT 3rd stage blade failure was considered to be a known issue, which had a developed corrective action in place.Engine ESN P771030 was inducted into the shop for high vibration 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 M/s Go airlines (India) Ltd. Which holds a scheduled operator permit AOP No. S-18 in Passenger and Cargo Category which is valid till

27.10.2022. M/s Go airlines (India) Ltd. currently hasseven A320-214 and fifty A320-271N (NEO),withatotalof 51 aircraft.

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.

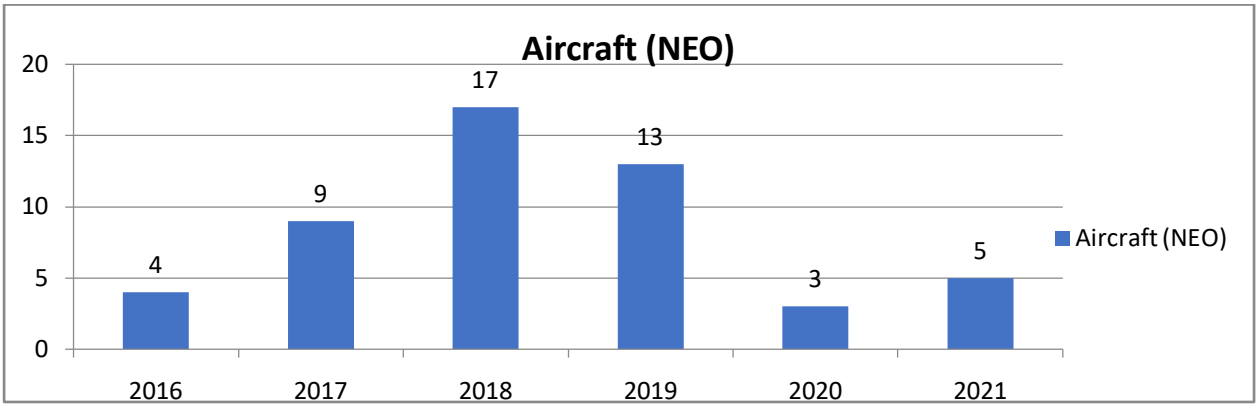

Figure 4: Yearwise induction of NEO fleet

1.18 ADDITIONAL INFORMATION

1.18.1 SIMILAR OCCURRENCES INVOLVING PW1127G-JMENGINES

Since the induction of PW1127G-JM engines in India in the year 2016, there have been a number of snags reported on aircraft fitted with these engines. Most of the snags were repetitive in nature. In order to prevent re-occurrence 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 Go Air (As of Dec 2020)
1.	Number3 bearing seal failure	Issued SB 72-00-087	All the Serviceable engines in Go Air fleet are complied with SB 72-00-0087
2.	Combustor failure	Issued SB72-00-0136	All the Serviceable engines in Go Air fleet are complied with SB 72-00-0136
3.	Low Pressure Turbine failure	Issued SB 72-00-0111	All the Serviceable engines in Go Airfleet are complied with SB 72-00-0111
4.	N2 Vibration	SB 72-00138 was released to replace HPC stage 6 ring seal with modified one.	42 engines in Go Air fleet are complied with SB 72-00-0138
5.	MGB IDG/LSOP gear failure.	Issued SB 72-00-0129	All the Serviceable engines in Go Air 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 3bearing 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 Visitreport of this entire engine wasshared 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 a report to AAIB.

VT-WJE was fitted with ESN P771030 at the time of incident. Given the similar nature of failure and findings of shop inspection, it is presumed that failure on ESN P771030 was 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 superalloy 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 GIVEN& ACTION TAKEN BY DGCA.

Taking cognizance of repeated failures of PW1127G-JMengines, DGCA issued instructions to operatorsstating that, each A320 NEO aircraft with PW1127G-JMengine (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 it 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 had complied with SB 72-00-0111 i.e., all its NEO fleet were installed with LPT modified engines by 31st August 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-WJE 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-offwhile climbing passing FL210, "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.

ATC was informed about the Air Turn Back at 12:31 UTC. After obtaining necessary clearance from ATC, Mumbai, the aircraft landed safely (withengine # 1running at IDLE till touchdown)at Mumbai at 12:50 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