



**Final Investigation Report on Ground Fatal Accident to
Air India Ltd. Airbus A-319 aircraft VT-SCQ at Mumbai
on 16.12.2015**

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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 2012, the sole objective of the investigation of an accident shall be the prevention of accidents and not apportion blame or liability.

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

Glossary

AAI	Airports Authority of India
AAIB	Aircraft Accident Investigation Bureau, India
AED	Aircraft Engineering Directorate, DGCA
A/F	Airframe Hours
AGB	Accessory Gearbox
AIATSL	Air India Air Transport Services Limited.
AIESL	Air India Engineering Services Limited
AIL	Air India Limited
AME	Aircraft Maintenance Engineer
AMM	Aircraft Maintenance Manual
AMP	Aircraft Maintenance Personnel
AMSL	Above Mean Sea Level
AOP	Air Operator Permit
APU	Auxiliary Power Unit
ARC	Airworthiness Review Certificate
ASDE	Airport Surface Detection System
ATC	Air Traffic Control
ATD	Actual Time of Departure
ATIS	Automatic Terminal Information Service
ATPL	Airline Transport Pilot Licence
AUW	All Up Weight
CAR	Civil Aviation Requirements
C of A	Certificate of Airworthiness
CFRP	Carbon Fiber Reinforced Polymer
CCIC	Cabin Crew In charge
CFOI	Chief Flight Operations Inspector
CG	Centre of Gravity
CLD	Clearance Delivery Unit
CPL	Commercial Pilot License
CVR	Cockpit Voice Recorder
CSIA	Chhatrapati Shivaji International Airport, Mumbai
CTE	Central Training Establishment
DAW	Director of Airworthiness
DGCA	Directorate General of Civil Aviation
DFDR	Digital Flight Data Recorder
DME	Distance Measuring Equipment
ETA	Expected Time of Arrival
<i>FCOM</i>	<i>Flight Crew Operating Manual</i>
<i>FCTM</i>	<i>Flight Crew Training Manual</i>
<i>FFS</i>	<i>Full flight simulator</i>
FRTOL	Flight Radio Telephone Operator's License
FSD	Flight Standard Directorate, DGCA
GSD	Ground Support Department
HP	High Pressure
HPC	<i>High Pressure compressor</i>

HPT	<i>High Pressure Turbine.</i>
IACO	International Civil Aviation Organization
IATA	International Air Transport Association
IFR	Instrument Flight Rule
IGB	Intermediate Gear Box
ILS	Instrument Landing System
IR	Instrument Rating
IST	Indian Standard Time
JEOC	<i>Jet Engine Overhaul Centre, Air India, Delhi</i>
LH	Left Hand
LP	Low Pressure
LPTN	Low Pressure Turbine Nozzle
L & T	Load & Trim
LTC	Line Training Captain
MCDU	Multi Control Display Unit
MIAL	Mumbai International Airport Limited
N1	Low Pressure Compressor Speed
N2	High Pressure Compressor Speed
NGV	Nozzle Guide Vane
OGV	<i>Outlet Guide Vane (gas turbines)</i>
<i>OSD</i>	<i>Operational Suitability data</i>
PAPI	Precision Approach Path Indicator
PDC	Pre Departure Clearance
PIC	Pilot In Command
PPC	Pilot Proficiency Check
Pax.	Passenger
<i>PANS-ATM</i>	<i>Procedures for Air Navigation Services - Air Traffic Management</i>
QFE	Query: Field Elevation
QNH	Query: Nautical Height
RGIA	Rajiv Gandhi International Airport, Hyderabad.
RH	Right Hand
<i>RNC</i>	<i>Reported Not coming</i>
<i>RTF</i>	<i>Radio Telephone</i>
<i>R/T</i>	<i>Radio Telephony</i>
SALS	<i>Short Approach Lighting System</i>
SLF	Supervised line flying
SMC	<i>Surface Movement Control</i>
SOD	Staff On duty
SOP	Standard Operating Procedures
STD	Scheduled Time of Departure
TAR/MSSR	Terminal Area Surveillance Radar/Monopulse Secondary Surveillance Radar
TDZ	Touchdown Zone
TGB	Tail Gearbox
THR	Runway Threshold
TIPO	Taxi In Push Out
T.E.	Trailing Edge

TRE	Type Rated Examiner
TRI	Type Rated Instructor
TSN	Time Since New
VFR	Visual Flight Rule
VHF	Very High Frequency
VOR	Very High Frequency Omni Range
U/S	Un-serviceable
UTC	Co-ordinated Universal Time

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FINAL INVESTIGATION REPORT ON GROUND FATAL ACCIDENT
TO AIR INDIA LTD. AIRBUS A-319 AIRCRAFT
VT-SCQ AT MUMBAI ON 16.12.2015

1.	Aircraft	Type	Airbus A-319
		Nationality	Indian
		Registration	VT-SCQ
2.	Owner & Operator	Air India Ltd	
3.	Pilot – in –Command	ATPL Holder	
	Extent of Injuries	None	
4.	Co-pilot	CPL Holder	
	Extent of Injuries	None	
5.	No. of Passengers on board	109 (Pax) + 04 (Cabin Crew)	
	Extent of Injuries	None	
6.	Date & Time of Accident	16.12.2015; 15:18:22 UTC	
7.	Place of Accident	B4 Taxi lane, abeam stands No. 29, CSIA, Mumbai.	
8.	Last point of Departure	Chhatrapati Shivaji International Airport (CSIA), Mumbai.	
9.	Intended landing place	Rajiv Gandhi International Airport (RGIA), Hyderabad.	
10.	Type of Operation	Scheduled Passenger Flight	
11.	Phase of operation	Start of Taxi	
12.	Type of accident	Fatal Injury to Ground Engineer during Taxiing	
13.	Co-ordinates of Accident Site,	19.0886° N, 72.8681° E	
	AMSL	37 ft. / 11 m	

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

SYNOPSIS

Air India Airbus 319 aircraft VT-SCQ Flight No. AI 619 was involved in an accident at 15:18:22 UTC on 16-12-2015 at CSIA Airport, Mumbai wherein the Ground Service Engineer was sucked in to the Right Engine during start of aircraft taxi. The aircraft was under the command of PIC having ATPL & Co-pilot having CPL. There were 04 cabin crew 109 passengers on board the aircraft.

The scheduled departure time of flight AI-619 (Mumbai - Hyderabad) was 1400 UTC. The flight was delayed as the PIC & Co-pilot was operating another flight AI 656 (Rajkot-Mumbai). The Rajkot aircraft arrived at Bay V30 R on 1505 UTC & crew rushed to V28L to operate AI 619. Another pilot flying to Hyderabad as SOD took the clearance from ATC for AI 619 in the absence of operating crew. During Pushback Left & Right engine were started. After reaching the required position on Taxiway B4, the parking brakes were put on. The PIC asked the Ground Service Engineer to disconnect the intercom headset and he responded with the same. The PIC confirmed with co-pilot for RH side clearance, for which the co-pilot responded affirmative. The PIC then put the parking brakes off, switch on the taxi light and gave power to taxi. However at that time all the 04 ground personnel were still around the nose of aircraft. In the meanwhile, the aircraft started moving and deceased Ground Service Engineer was standing facing back towards the aircraft with headphone on his head. The aircraft RH engine came very close to the deceased and sucked him. All the other ground personnel ran away from the aircraft and the tow truck driver also took the tow truck away from the aircraft leaving tow bar. The nose wheel of the aircraft hit the tow bar and the tow bar got stuck with the RH main landing gear wheel. The pilot stopped the aircraft and switched off the RH & LH Engine. Later after around 09 minutes, ground personnel connected the PIC through intercom headset and appraised the pilot about the situation. The deceased Ground Service Engineer received fatal injuries and died on the spot.

After the accident, passengers were shifted to another aircraft VT-SCN at stand K4L and aircraft departed as flight AI-619 at 18:26 UTC. The aircraft VT-SCQ was shifted to hanger at 23:23 UTC.

Ministry of Civil Aviation vide order No. AV 15029/118/2015-DG dated December 2015 constituted a committee of inquiry to investigate the cause of the Accident under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2012. The committee includes Sh. Amit Gupta, Director-AED, DGCA as Chairman, Sh. Raje Bhatnagar Assistant Director, AAIB and Sh. K. Ramachandran Air Safety Officer, AAIB as member.

The probable cause of Accident was “Non adherence to Standard Operating procedures (SOP) & delayed departure of flight due improper rostering of crew, resulted in the accident.”

1. FACTUAL INFORMATION.

1.1 History of flight

On 16.12.2015, Air India A319 aircraft VT-SCQ was scheduled to operate flight AI-619 (Mumbai - Hyderabad). Both the cockpit crew were earlier scheduled to operate Mumbai-Rajkot-Mumbai on A 320 aircraft and Mumbai- Hyderabad –Mumbai on A 319 aircraft. As per schedule ETA for flight AI-656 (Rajkot – Mumbai) was 14:40 UTC and the aircraft reached Bay V30R at 15:05 UTC. As per schedule AI 619 (Mumbai-Hyderabad) STD was 1400 UTC which was further delayed due late arrival of AI - 656. Thereafter both cockpit crew got down from the aircraft and rushed to Bay V28L on which the aircraft VT-SCQ was parked to operate AI-619. Earlier, the aircraft VT-SCQ arrived at Bay No. V 28L from Hyderabad operating Flight No AI 618 at 13:09 UTC.

As per the statement of PIC, another pilot of Air India who was Staff off duty (SOD) and was on board the flight AI-619, as passenger took clearance from ATC and fed the data in MCDU before the PIC entered in the cockpit. CCIC of the flight AI- 619 allowed him to enter the cockpit and fed the data before the cockpit crew arrived. Pushback was started at around 15:15 UTC. #2 and #1 engine started after taking clearance from Ground Service Engineer during pushback. After reaching the required position on Taxiway B4, the deceased Ground Service Engineer informed the pilot on intercom that pushback is complete, put the brakes on. As advised, the parking brakes were put on by the PIC. The PIC then asked the Ground Service Engineer to disconnect the headset and he responded with the same. There were 04 persons on ground for departure of the aircraft, the deceased Service Engineer, 01 Engineering Helper, 01 GSD helper and the tow truck operator. The departure AME was not present during the departure of the flight as he went to washroom and to check the arrival of another aircraft in the building.

The chokes were placed on the nose wheel by the GSD helper. The engineering helper disconnected the tow bar from the Truck first and then subsequently from the aircraft. The tow truck driver took the truck to the right side of the aircraft at 90 degrees facing the terminal building. Thereafter the engineering helper started connecting the tow bar to the Truck. Meanwhile the deceased Ground Service Engineer asked the GSD helper to take the chokes off; the GSD helper took the chokes off the nose wheel and then kept it on the tow Truck. Thereafter the GSD helper started assisting the engineering helper in connecting the tow bar with the Truck. The PIC confirmed with co-pilot for RH side clearance as the ground personnel were on the RH side of the aircraft for which the co-pilot responded affirmative. The pilot then put the parking brakes off, switch on the taxi light and gave power to taxi. However at that time all the 04 ground personnel were still around the nose of the aircraft.

As per the statement of the GSD helper and tow truck operator, the deceased Ground Service Engineer removed the nose wheel steering pin and was standing at the same position and was probably observing the GSD helper and engineering helper trying to connect the tow bar with the truck. Meanwhile, the aircraft started moving with engine power. The deceased Ground Service Engineer was standing at the same point, facing back towards the aircraft with headsets on his head, not realising that the aircraft has started moving. The aircraft No.#2 engine came very close to the deceased Ground Service Engineer and sucked him. All the other ground personnel ran away from the aircraft and the tow truck driver towed the tow truck away from the aircraft leaving tow bar. The nose wheel of the aircraft hit the tow bar and the tow bar got stuck with the RH main landing gear wheel. The pilot stated that he heard thud sound twice and after the second thud sound, he immediately stopped the aircraft. He also stated that

someone from the RH side came running towards the aircraft and signalled to shut off the engine. The pilot shut off the No. # 2 engine first and then shut off the No.# 1 engine. Later after 09 minutes ground personnel connected the intercom headset and apprised the pilot about the situation. The accident happened at around 15:18:22 UTC. The Ground Service Engineer received fatal injury. From the DFDR data it is observed that the elapsed time of 36 seconds from the moment when aircraft pushback is complete at taxiway B4 to the moment aircraft commences taxi. After the accident, passengers were shifted to another aircraft VT-SCN at stand K4L and aircraft departed as flight AI-619 at 18:26 UTC. The aircraft VT-SCQ was shifted to hanger on 23:23 UTC (17/12/2016 at 04:53 IST).

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	NIL	NIL	01*
Serious	NIL	NIL	NIL
Minor	NIL	NIL	NIL
None	2+4	109	NIL

(*) Ground Service Engineer Received fatal Injury due ingestion in Engine.

1.3 Damage to aircraft.

The aircraft sustained minor damage. Following main damages occurred to the aircraft.

1. Nose wheel No. 1 & No.2 found damaged as aircraft nose wheel hit tow bar
2. Service door of external power connector was deformed and was not closing properly.
3. Nose cowl of Engine No. 2 found ruptured at 3 places (3 O'clock, 9 O'clock, and 10:30 O'clock).
4. Human Remains found inside primary & secondary core of engine No. 2.

1.4 Other damage: Minor Damages on the tow bar end and tow bar wheel was tilted due rubbing with the ground.

1.5 Personnel information:

1.5.1 Pilot – in – Command:

Age	55 Years 06 months
Date of Joining Company	08-08-1989
License	ATPL
Date of Issue	12-01-1996
Endorsement Date and Type of Aircraft	B737 on 1 st July 1991 A320 as P2 on 12-10-1994
Command Training date of PIC A320	29-01-2002
Check Pilot Approval	03-09-2007
TRI Approval	23-09-2013
Training Experience on SIM	344 hrs

IR/PPC done	10 th July 2015
Validity of license up to	03-12-2020
Category	Aeroplane
Class	Single/Multi Engine land
Type endorsement	Cessna 152, Cessna 172, PA-34, A-320, A-319,A-321
Date of Medical Examination	07-09-2015
Medical Examination valid upto	06-03-2016
FRTTO License issue	28-02-1989
FRTTO License valid upto	15-12-2018
Total Flying Experience	18402:57 hrs
Total Flying Experience on Type	17144:07 hrs
Total Flying Experience as P1 on Type	12273:12 hrs
Total Flying Experience during last 180 days	510:15 hrs
Total Flying Experience during last 90 days	282:45 hrs
Total Flying Experience during last 30 days	103:00 hrs
Total Flying Experience during last 07 days	19:15 hrs
Total Flying Experience during last 24 hours	02:40 hrs
Rest period prior to duty flight on 16-12-2015	48 hrs.
Last flown on Type (A 320 family)	16-12-2015

The PIC had weekly off on 14th December 2015 and was not rostered for duty on 15th December 2015. The accident flight on 16-12-2015 was his 3rd flight of the day. Earlier he had operated Mumbai- Rajkot- Mumbai flight on A 320 aircraft.

1.5.2 Co-Pilot:

Age	35 Years
Date Of Joining Company	15/06/2015
License	CPL
Date of Issue	25-06-2008
Valid up to	24-06-2018
Category	Aeroplane
Class	Single/Multi Engine land
Type endorsement	Cessna 152, Beech Baron B-55
Date of Endorsement as Co-pilot A 320 (Endorsement Training from Egypt Air Aviation Training Centre)	27-07-2011
Date of Endorsement as Co-pilot A 319 /A321 (Air India CTE)	17-08-2015
Date of Medical Examination	21-09-2015
Medical Examination valid upto	20-09-2016
FRTTO License issue	25-06-2008
FRTTO License valid upto	24-06-2018
Total Flying Experience	444 hrs
Total Flying Experience as P2 on A 319 / A320 / A321Type	86 hrs
Total Flying Experience during last 180 days	86 hrs

Total Flying Experience during last 90 days	86 hrs
Total Flying Experience during last 30 days	71 hrs 50 min
Total Flying Experience during last 07 days	20 Hrs 50 min
Total Flying Experience during last 24 hours	02 hrs 40 min
Rest period prior to duty flight on 16-12-2015	48 hrs.
Last flown on Type (A 320 family)	16-12-2015
SLF Training Base	Mumbai

The co-pilot had weekly off on 14th December 2015 and was not rostered for duty on 15th December 2015. The accident flight on 16-12-2015 was his 3rd flight of the day. Earlier he had operated Mumbai- Rajkot- Mumbai flight on A 320 aircraft.

1.5.3 Aircraft Maintenance Engineer:

Age	59
Sex	MALE
Date of Joining Air India	23-12-1982
Date of becoming AME	08-08-2007
License Date of Issue/ Validity	13-09-2000 & valid up to 20-06-2017
Endorsement on Cat. 'A'- A319	28-02-2011
Training on Cat. 'C' – CFM 56-5B Engine	15-12-2011
Total Aviation Experience	33 years
Total Experience as AME	8years 04 months

1.5.4 Senior Service Engineer:

Age	54
Sex	MALE
Date of Joining Air India	30-01-1992
Total Aviation Experience	23 years 10 months

1.6 Aircraft Information

1.6.1 Aircraft Information

The Airbus 319 aircraft VT-SCQ is a subsonic, medium-range, Civil Transport Aircraft. The aircraft has two high bypass turbofan engines manufactured by CFM International, USA. The aircraft is designed for operation with two Pilots and has passenger seating capacity of 122 (114+8).

The aircraft is certified in normal (Passenger) category, for day and night operation under VFR & IFR. The maximum operating altitude is 39800 feet and maximum Take-off weight is 68000 kgs. The maximum Landing weight is 61000 kg. The Aircraft length is 33.84 meters, wingspan in 34.10 meters and height of this aircraft 12.11 meters. The distance between main wheel

center is 7.59 meters. The distance between engines is 11.50 meters and Engine Ground Clearance is 0.56 meters.

A319 aircraft fuselage is a semi monocoque structure having five main section. The structure is primarily made of chemically milled skin panels attached with frames and stringers made of sheet metal. The fuselage has got total 80 No. of frames in which frame No. 1 is forward pressure bulkhead and frame No. 70 is rear pressure bulkhead. Frame No. 70 to 80 is unpressurised zone. In general standard frames have a common Z-shaped section made of formed sheet which provides continuous structural integrity to stringers and skin panels through sheet metal cleats.

Two wings on each side of the fuselage is attached through a centre wing box at the middle of the fuselage (frame 36 to frame 42). Wings are joined with the fuselage by means of Cruciform fittings at upper end and Triform fittings at lower end between centre and outer wing box. Wing box are generally box structure having front and rear spar with 27 ribs in between along each outer wing and the whole things are covered with skin panels. Wings carry the landing gear, engines and flight control devices. Wing also carry the fuel inside the box cavity.

Primary control surfaces are aileron on both wings, elevator on horizontal stabilizer T.E and rudder on vertical stabilizer T.E. Secondary control surfaces are flaps, slats and spoilers. All control surfaces are electrically control and hydraulically operated. Control surfaces are generally having box structure made of CFRP.

A319 aircraft VT-SCQ is fitted with CFM56-5B engines manufactured by CFM International, USA (50-50 joint venture of SNECMA, FRANCE & GE Aviation, USA).

The CFM56-5B engine is a dual rotor are variable stator high bypass turbofan engine. The engine is made of four primary modules.

The fan & LP compressor are supported by the fan frame which host forward engine mount. Four stage LP Turbine drives the forward fan and the four stage booster compressor. LP turbine is supported by TRF which host rear engine mount. The high pressure rotor is made of nine stage HP compressor driven by single stage HP turbine. The annular combustion chamber is located between HPC & HPT and is equipped with ports for 20 fuel nozzles and ignitor plugs. The accessory gear box is located at the bottom of the fan case and is driven by HP rotor through transfer gear box. The fuel pump, oil pump, hydraulic pump and other accessories are driven by the gear box.

Airbus A319 aircraft VT-SCQ (MSN 3918) was manufactured in the year May 2009. The aircraft is registered under the ownership of M/s. AIR INDIA LTD. The Certificate of registration No.3955/3 under category 'A' was issued on 12/12/2011. On the day of accident, the aircraft VT-SCQ had logged 16559:24 airframe hours and 11721 cycles. 4672:24 Hrs were logged since last C of A. Airworthiness Review Certificate (ARC) was issued on 21-04-2015 and valid up to 20-04-2016.

The aircraft was holding a valid Certificate of Airworthiness Number 6064 issued under normal category sub-division passenger/ Mail / Goods by DGCA on 28/05/2009 and was valid up till 27/05/2019. The aircraft is holding aero mobile License No. A-014/084-RLO (NR) and was valid on the day of accident. This aircraft was operated under Scheduled Operator's permit No.

AOP # S-9 and which was valid till 30/06/2018. Prior to flight the aircraft was holding a valid Certificate of Flight Release.

The aircraft was last weighed on 23/04/2014 at IGI Airport, New Delhi and weight schedule was prepared and duly approved by the office of DAW, Kolkata. As per the approved weight schedule the Empty Weight of the aircraft is 41713 kgs. Maximum usable fuel quantity is 19005 kg. Maximum payload with full fuel tanks is 7282 kgs. Empty weight CG is 17.21 meters aft of datum. The next weighing is due on 22/04/2019.

The aircraft and Engines were being maintained under continuous maintenance as per maintenance program consisting of calendar period based maintenance and flying Hours/Cycles based maintenance as per maintenance program approved by O/o DGCA, DAW/Q3-AIL/3255 dated 04/12/2014. The last Major Inspection 2420 Days (A+2A+P15) inspection was carried out at 16427:36 hours / 11612 cycles on 27/11/2015. Subsequently all lower inspections (Pre-flight checks, Service Checks, Weekly Checks) were carried out as and when due before the accident.

Scrutiny of snag register revealed that there was no snag reported on the aircraft prior to the accident flight. The last snag recorded in the snag register on 15-12-2015 was "APU U/S". The snag was rectified and no further snag was recorded in the register.

Engine	Serial No.	TSN	CSN Cycle
#1	697831	21305:51hrs	13305
#2	699788,	20578:23 hrs	10772

The last fuel microbiological test was done on 27.11.15 at Kolkata by Air India Ltd. and the colony count was within acceptable limits.

Computerized Load & Trim sheet was made for VT-SCQ operating flight AI 619. The Details of basic weight schedule were as follows:-

Weight	Maximum Permissible (Kg)	Actual Weight (Kg)
Take-off weight	62840	59554
Landing weight	61000	57019
Zero Fuel weight	57000	51704

Dry Operating weight for the flight was 41618 Kgs. Take off fuel available was 7850 Kgs and trip fuel was 2535 Kgs. CG was within the prescribed limit during take-off and landing.

1.7 Meteorological information:

The weather at Chhatrapati Shivaji International Airport (CSIA), Mumbai is as under.

Time in UTC	Wind Direction	Speed (K)	Vis (m)	Weather	Clouds	Temp (°)	Dew Point	QFE hPa	QNH hPa	Trend
1400	010	08	2500	FU	Few AC 100	26.5	18.1	1010.6	1011.4	NOSIG
1430	320	07	2500	FU	NSC	26.4	17.4	1011.0	1011.8	NOSIG
1500	360	06	2500	FU	NSC	26.2	17.1	1011.2	1012.0	NOSIG
1530	270	05	2500	FU	NSC	26.4	17.6	1011.4	1012.2	NOSIG
1600	360	03	2500	HZ	NSC	25.4	17.9	1011.7	1012.5	NOSIG
1630	020	09	2500	HZ	NSC	25.6	17.6	1011.8	1012.6	NOSIG
1700	VRB	02	2500	HZ	NSC	25.7	16.9	1011.8	1012.6	NOSIG

1.8 Aids to navigation:

Mumbai airport is equipped with VOR (frequency 116.60 MHz), DME (frequency 1200/1137 MHz), NDB (frequencies 396 kHz), ASDE (frequency 9375 MHz). PAPI & ILS Cat- II is installed on Runway 27. PAPI & ILS Cat-I is installed at 09 & 14 and SALS is installed at Runway 32.

1.9 Communications:

At the time of accident the aircraft was in contact with Mumbai ATC on frequency 121.75 MHz (SMC-II). From the tape transcript it was apparent that there was no communication problem between the Flight Crew & ATC. Another pilot (SOD) took clearance and Squawk from Mumbai ATC on frequency 121.85 MHz (PDC) before operating crew arrived.

The Communication frequencies for Tower are 118.1 MHz, Approach Mumbai Control (N) is 132.7 MHz, Approach Mumbai Control (S) is Approach Mumbai Control (N) is 132.7 MHz SMC Controller Mumbai Ground is 121.9 MHz / 121.85 / 121.75 MHz, TAR/MSSR Radar 127.9 MHz / 119.3 MHz, Mumbai Radar (N) 132.7 MHz / 120.5 MHz, Mumbai Radar (S) 125.35 MHz / 120.5 MHz and ATIS Broadcast is at 126.4 MHz.

Salient observations made from the tape transcript (between SOD Pilot AIC 619 and PDC) at frequency 121.85 MHz (Pre Departure Clearance) from 14:58:18 UTC to 15:07:53 UTC are given below:

1. The SOD pilot of AI 619 called for Pre Departure Clearance.
2. The clearance was given with Squawk code and advised to contact SMC.
3. PDC informed AI 619 regarding delay of 10 minutes.
4. PDC informed AI619 regarding delay of 05 minutes and standby for change over.
5. PDC advised AI 619 to contact 121.75.

Salient observations made from the tape transcript (between Pilot AIC 619 and ATC) at frequency 121.75 MHz (SMC-II) from 15:14:07 UTC to 15:28:50 UTC are given below:

1. AI 619 contacted SMC.
2. SMC approved pushback and start up.
3. AI 619 requested Taxi.
4. SMC cleared AI 619 for Taxi giving instructions.
5. AI 619 acknowledged the Taxi instructions.
6. AI 619 informed SMC that they are holding due some technical problem.
7. SMC cancelled the Taxi clearance of AI 619.
8. AI 619 informed SMC that there is an accident and can't move the aircraft.

1.10 Aerodrome information.

Chhatrapati Shivaji International Airport (CSIA) is an international airport located in Mumbai, Maharashtra. The IATA location Identifier code is BOM and ICAO location Indicator code is VABB. The airport is operated by Mumbai International Airport Limited (MIAL), a Joint Venture between the Airports Authority of India (AAI) and a consortium led by GVK Industries Ltd. The elevation AMSL of airport is 11.9 m (39.1 ft). The airport is licensed by DGCA No. AL/Public /005 for both IFR and VFR traffic. The airport reference code is 4F. The airport has two cross runways made of Asphalt. The length of Runway is as under

- **Rwy 27--** 3448m × 60m
- **Rwy 09 --** 3188m × 60m
- **Rwy 14/32--** 2871m × 45m

The Airport Reference point is 19°05'30"N 072°51'58"E. Runway has marking for Designation, THR, TDZ, Centreline, Rwy Edge and is lighted for THR, Edge, End, TDZ, and Centreline. The Airport Rescue and Fire Fighting Services was Category '9' (Nine).

1.11 Flight recorders.

The aircraft was fitted with Solid State CVR & DFDR manufactured by L-3 Communications, USA. The CVR & DFDR were removed from the aircraft after the accident & data from CVR & DFDR were downloaded and analysed. The CVR unit Sl. No. 000623355 and part No. 2100-1025-02. The DFDR unit Sl. No. 000487019 and part No. 2100-4043-02.

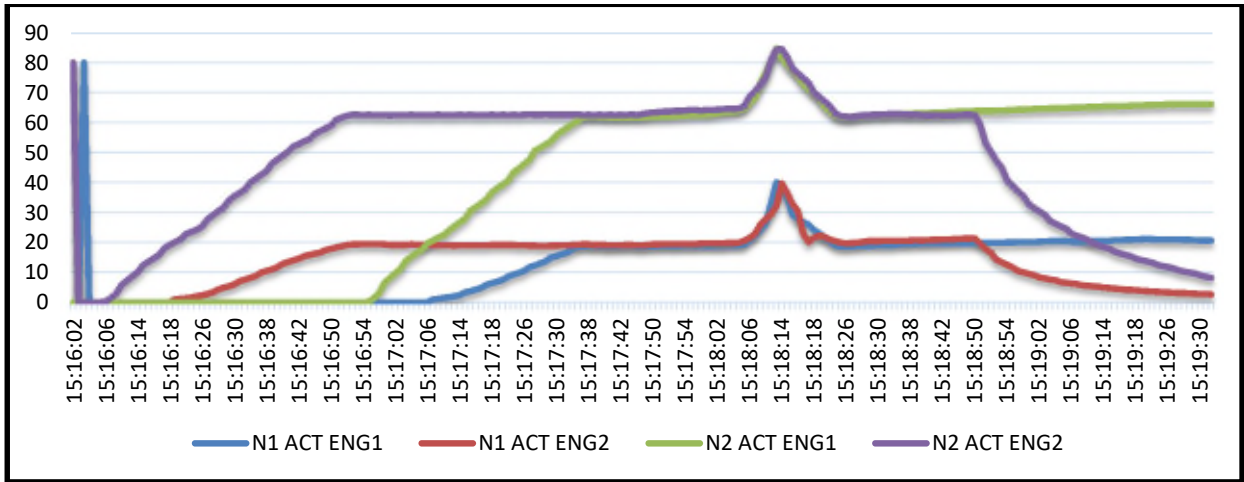
A total of last 02:04:14 hrs Audio data was available in CVR. Salient observations made from the CVR tape transcript are given below:

- PIC was handling the communication with Ground Service Engineer on intercom headset & Co-pilot was handling the communication with ATC.
- PIC requested Engine start during Pushback from Ground Service Engineer.
- No #2 Engine was started first then No. #1 Engine was started.
- After pushback was completed at B4, Parking brakes were applied.
- The PIC then asked the Ground Service Engineer to disconnect the headset and he responded with the same.

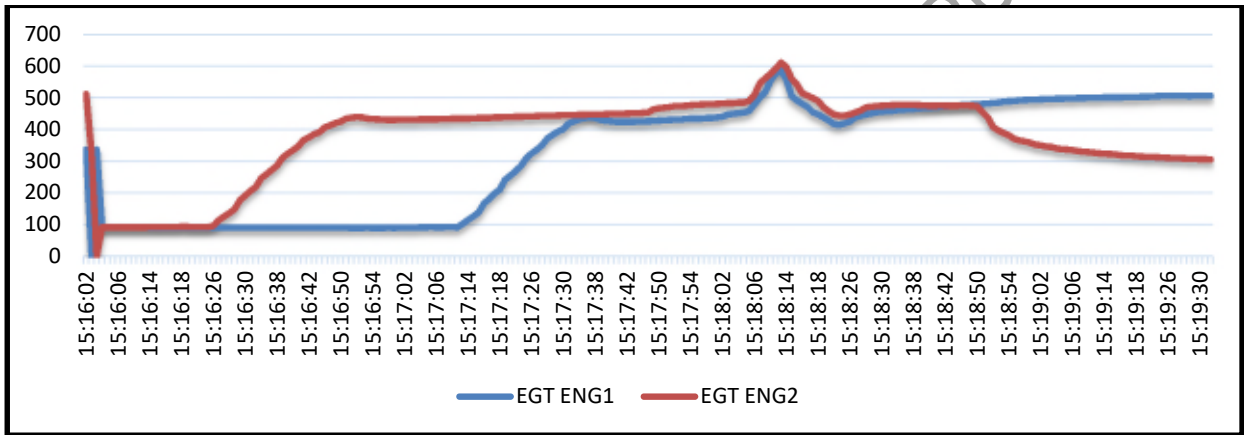
- Co-pilot requested for Taxi clearance from Mumbai ATC and received clearance from ATC
- The PIC confirmed with co-pilot regarding “Right Clear” for which the co-pilot responded “Right is clear”.
- After the accident, PIC checked with co-pilot “*Usne haath dikhaya tha*” for which co-pilot responded “*Haan sir haath dikhaya tha*”.

DFDR analysis was carried out and following observations were made:-

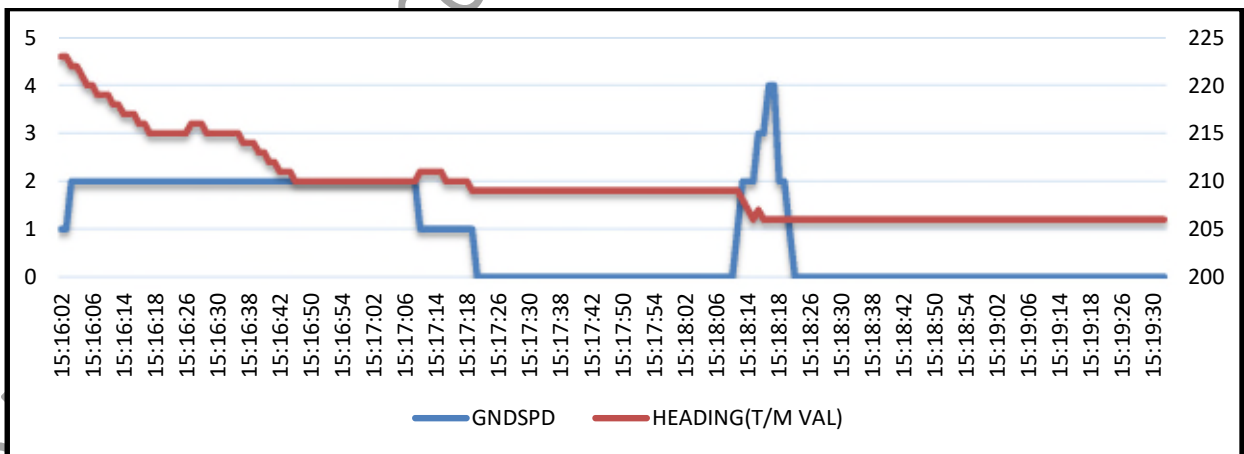
- At 15:14:26 UTC parking brake is released, both engines off. Aircraft heading 270.
- At 15:15:10 UTC aircraft commences push back (heading change observed in DFDR).
- At 15:16:02 UTC # 2 engine start initiated, aircraft being push back.
- At 15:16:54 UTC # 1 engine start initiated, aircraft being push back.
- At 15:17:30 UTC parking brakes are set (applied). Aircraft push back complete (aircraft heading 209).
- At 15:17:34 UTC both engines reach stabilized rpm.
- At 15:18:06 UTC parking brake is released.
- Aircraft ground speed is observed to be increasing and maximum ground speed recorded is 4 knots.
- At 15:18:22 UTC probable time of accident as # 2 engine N1 vibration observed to be increasing from 0.3 to a maximum value of 3.6 which is recorded at UTC 15:18:46.
- At the time of accident No # 1 engine N2 was 81.69% & N1 was 39.13% and No # 2 engine N2 was 84.56% and N1 was 39.69%.
- At 15:18:38 UTC parking brake is set (applied). Aircraft heading is 206. Both engines are running.
- At 15:18:50 UTC engine # 2 master is selected off.
- At 15:25:10 UTC engine # 1 master is selected off.



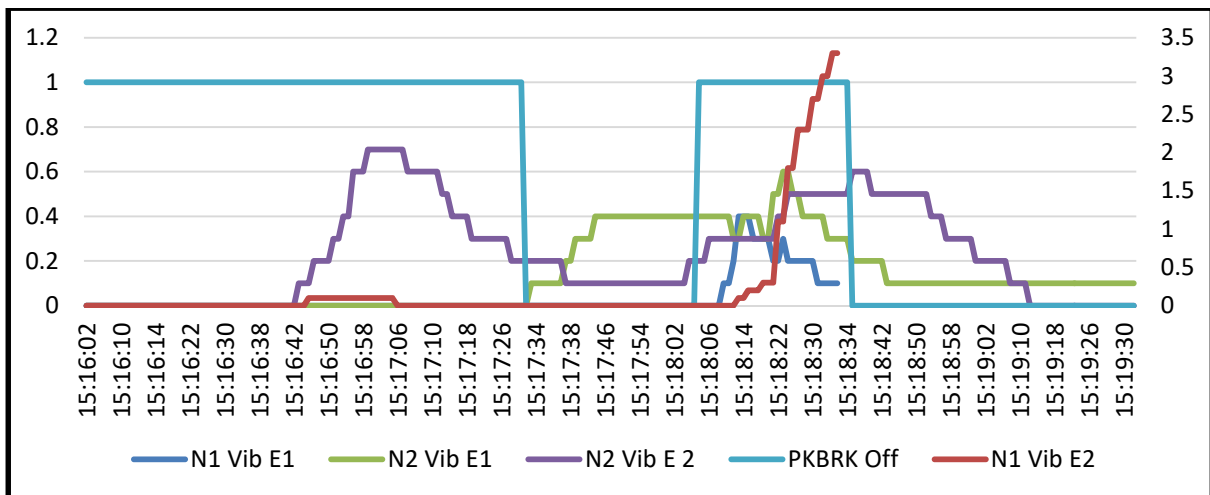
Graph between N1, N2 of Engine 1 & Engine 2



Graph between EGT of Engine 1 & Engine 2



Graph between Heading & Ground Speed



Graph between Engine Vibration & parking brake

1.12 Wreckage and impact information.

The nose wheel of aircraft hit tow-bar tangentially and damaged both nose wheels and tyres. There was 1 meter long mark on taxiway due Tow bar rubbing on taxiway.

1.13 Medical and pathological Information:

Prior to operating the Rajkot flight, both the Cockpit crew had undergone pre-flight medicals / Breath analyzer test at Mumbai and were found to be negative. After the accident both the cockpit crews and all the 04 Ground crew were subjected to Breath analyzer test and found negative.

1.14 Fire:

There was no pre or post impact fire.

1.15 Survival aspects:

The accident was not survivable. Though there was no Injury to any passenger / crew but the ground Service Engineer received fatal injuries. As per post- mortem report the provisional cause of death was due to "Hemorrhage shock due to crush injury."

1.16 Tests and research:

Nil

1.17 Organizational and management information:

Air India Limited, is a Scheduled Airlines and operates a fleet of Airbus and Boeing aircraft. The airline was issued Air Operator's Permit (AOP) No. S-9 in Category "Passenger and Cargo" by DGCA and is valid up to 30.06.2018. The Airline IATA Code is "AI", ICAO code

“AIC” and call sign “Air India”. The airline operates a fleet of 113 aircraft includes 24 Airbus A319-100 aircraft, 28 Airbus A320-200 aircraft, 20 Airbus A321-200 aircraft , 05 Boeing 747-400 aircraft, 15 Boeing 777 aircraft and 21 Boeing 787. Air India is having 02 Subsidiaries as Air India Express & Air India Regional which have separate permit. The airline operates at 84 destinations (48 Domestic + 36 international) and having approx. 28000 employees. The airline has headquarter in New Delhi. Its primary hub is at Indira Gandhi International Airport, New Delhi, and secondary hub at Chhatrapati Shivaji International Airport, Mumbai.

1.18 Additional information:

1.18.1 Engines Strip Examination of Starboard Engine (ESN 699788)

During preliminary inspection at JEOC, New Delhi, no external damage was observed. During strip Examination at Jet Shop, following are the observations:-

1. Heavy rub marks and missing material of abraidable liner observed at few locations.
2. Fan blades were found to be very difficult to remove from fan disk dovetail slots as the usual gap between mid-span shrouds of fan blades was filled with human remains/debris, mallet was used to free the blades from each other.
3. Space between upstream fan case and Front acoustic panels is filled with human remains/ debris at many locations.
4. Many OGVs show sighs of damage and require extensive cleaning as human remains/ debris observed clinging to most of them.
5. Inlet of booster also shows human remains/ debris at outer circumference at many locations.

OBSERVATIONS ON ENGINE MODULES:

HPC ROTOR MODULE	:	Erosion observed on blades. No other abnormality noted.
HPC FRONT STATOR MODULE	:	Deep grooves noted on retainer seal. No other abnormality noted.
HPT NGV MODULE	:	As viewed from T.E. burns & erosion associated with high life of engine observed. No other abnormality noted.
HPT MODULE	:	No abnormality other than coating burn on blades.
HPT SH. & LPTN MODULE	:	No abnormality other than coating burn on shrouds.
LPT MODULE	:	No abnormality noted.
No. 1 & 2 BEARING SUPPORT ASSY	:	
IGB & No. 3 BEARING ASSY	:	Found satisfactory
TGB ASSY	:	Found satisfactory
AGB ASSY	:	Found satisfactory

1.18.2 Size comparison between Airbus A-320 aircraft and A-319 aircraft

S. No.	Dimensions	Airbus A 320	Airbus A 319
1.	Aircraft length	37.57 meters	33.84 meters
2.	Height	12.11 meters.	12.11 meters.
3.	Wingspan	34.10 meters	34.10 meters
4.	Track	7.59 meters	7.59 meters
5.	Distance between engines	11.50 meters	11.50 meters
6.	Engine Ground Clearance	0.56 meters	0.56 meters
7.	Engine to nose of aircraft	11.19 meters	9.6 meters
8.	Engine Type	CFM 56-5B	CFM 56-5B
9.	Engine Thrust	27000 lbs	23500 lbs

1.18.3 Aircraft Pushback & Procedure

Pushback means the movement of an aircraft from a nose-in parking stand using the power of a specialised ground vehicle attached to or supporting the nose landing gear. It is commonly the second part of a 'Taxi In Push Out' (TIPO) procedure at airport terminal gates and will be necessary to depart from all except self-maneuvering parking stands unless the aircraft type is capable of powerback and local procedures allow this. Occasionally, a pushback may need to be followed by an engines-running pull forward to a position where local procedures allow aircraft to move forward under their own power, but usually, ground vehicle disconnection will occur after the completion of a pushback.

Once the aircraft commander (or other person in charge on the flight deck if the aircraft is not in service) has given their confirmation of 'brakes released' to the person in charge of the ground crew who are to carry out the pushback, the ground crew become temporarily responsible for the safe manoeuvring of the aircraft in accordance with either promulgated standard procedures or as specifically agreed beforehand.

Unless the manoeuvre is taking place outside the movement area controlled by ATC, an RTF clearance to carry it out will be required. Usually but not always, this will be obtained by the aircraft commander or other person in charge in the flight deck. The prescribed RTF phraseology for pushback is contained in ICAO PANS-ATM.

Formerly, almost all aircraft types required that the ground locking pin be installed in the nose landing gear during any pushback; however, this is now no longer always the case. If a ground locking pin is installed for the pushback, it will need to be removed after the completion of the ground vehicle manoeuvre if the aircraft has been pushed back prior to intended flight.

The 'traditional' method of allowing the ground vehicle to move an aircraft is to attach it to the aircraft nose landing gear by means of a towbar. These must be approved for use with a particular aircraft type and clearly marked as such, since there is no universal towbar

specification. The same towbar attachment and ground vehicle may also be used for Aircraft Towing in the forward direction. An alternative method which is becoming more common for pushback is the use of a specialised vehicle called a 'towbarless tug'. This positions two low level 'arms' either side of the aircraft nose landing gear and these are used to engage with the aircraft gear leg and raise it slightly off the ground. These specialised vehicles can also be used to tow aircraft forward,

Both pushback methods are subject to the observance of any aircraft limits for maximum nose landing gear steering angle, but these are not usually especially restrictive.

The responsibilities of the ground crew team carrying out a pushback include ensuring that no part of the aircraft structure will impact any fixed object or other aircraft and may include giving clearance to start one or more engines just before, during or immediately after a pushback. The number of people assigned to a ground crew team for a pushback may vary according to aircraft size, but in most cases will be at least three. One will be driving the pushback vehicle, one will be walking in the vicinity of one of the aircraft wingtips and looking beyond the aircraft tail and one will be in charge of the manoeuvre and in communication with the person with aircraft responsibility in the flight deck. Communication between the ground crew supervisor is usually by means of a plug in to an aircraft ground intercom circuit; if so, this is facilitated by a ground crew microphone which acquires the voice of the user whilst excluding background noise, which if the aircraft engines are running can be considerable. If only two ground crew are used for pushback of a smaller aircraft then it is important that the procedure takes full account of the roles of each ground crewmember and that the person in charge of ground crew communications on the flight deck is aware of the number of ground crew being used and the physical location of the supervisor.

Effective communication between the person in charge in the flight deck and the person in charge of the ground crew, and between the members of the ground crew team is critical. If the aircraft is being pushed back prior to intended flight and the person in charge of the flight deck is therefore an aircraft commander, the procedures of the aircraft operator may require that the designated Pilot Flying, who may be the copilot, should oversee the pushback and in this case all communications with the ground crew will be undertaken by that person rather than necessarily by the aircraft commander. If it is considered that communication by hand signals rather than intercom is acceptable then it is essential that the applicable procedures are comprehensive and thoroughly understood by both parties and that they cover all possible abnormal and emergency circumstances.

The case of engines-running pull forward as a supplementary action prior to ground vehicle disconnection after a pushback should be considered as part of the pushback procedure and trained accordingly since it bears little practical resemblance to the towing for longer distances of empty out-of-service with engines stopped.

Engine Starts may be routinely accomplished immediately before or during pushback. Where they are carried out when the aircraft is moving, it is essential that the ground crew supervisor

does not allow the checks and communication required in connection with engine starting to interfere with their primary responsibility to control the pushback and remain in full communication with those on the flight deck using the means available. Many aircraft operators require that when push back is accomplished without headset communications, engine starts do not take place whilst the aircraft is being pushed, preferring instead to require that engine starting takes place before or after completion of the pushback. Observations of abnormal circumstances in connection with engine starts or any other matter affecting, or potentially affecting the safety of the aircraft during a pushback are of great importance to those on the flight deck but it is essential that any descriptions of external observations during engine starts are imparted accurately; this may sometimes be demanding using ground intercom but can be extremely difficult with only hand signals available.

If damage is caused to the aircraft on pushback, or to another aircraft by the aircraft on pushback, this must be identified and technically assessed before that aircraft flies. Unfortunately, this is not always the case. It is important to recognise that when part of one aircraft impacts part of another aircraft, the degree of resultant damage may vary between negligible and major, even if the aircraft are identical. Ground Crews must be effectively briefed on this as well as other aspects of the operation. This is especially important when the ground crew are not employed directly by the aircraft operator or if they do not speak the same language fluently for operational communications.

The evidence of accidents and incidents is that there are a number of recurrent features of aircraft damage during pushback:

- Use of hand signals rather than intercom communication,
- Lack of intercom clarity in communications between the aircraft and the ground crew supervisor,
- Ground crew totaling less than three people,
- Departure from non-air bridge gates,
- Failure of vehicle driver to maintain adequate communication with supervisor,
- Lack of clearance between horizontal stabilisers of adjacent 'T' tail aircraft,
- Pushback commenced from a parking position different from that marked,
- Ground crew poorly trained or unfamiliar with the immediate pushback environment,
- Unserviceable towbars attributable to lack of ownership clarity,
- Surface contamination obscuring pavement markings.

1.18.4 Air India Engineering Service Ltd. Staff Notice 01 of 2015

Air India Engineering Service Ltd. Staff Notice 01 of 2015 dated 01-09-2015 give detailed procedure regarding Installation/ removal of Chocks, safety cones during Pushback at CSIA Airport, Mumbai. The staff notice states:-

Quote

“The following standard procedure for installation and removal of chocks and safety cones for Air India A320 family aircraft in Chhatrapati Shivaji International Airport, Mumbai has been decided by the undersigned, based on the requirements of Air India Limited and the regulatory authority. All staff of AIL/ AIESL/ AIATSL, who are associated with the installation and removal of chocks/ safety cones and aircraft pushback must adhere to this procedure.

Procedure for Installation of Chocks and Safety Cones on Arrival of Aircraft in Chhatrapati Shivaji International Airport, Mumbai

1. *On arrival of the aircraft at the parking bay, the Aircraft Maintenance personnel of AIESL should establish communication with the cockpit crew through the aircraft interphone system using the headset in normal conditions. In case of thunderstorm/ near thunderstorm, standard hand signals should be used instead of headset.*

WARNING:

USE OF HEADSET DURING THUNDERSTORM CAN CAUSE FATAL INJURY TO PERSONNEL. HENCE THE HEADSET SHOULD NOT BE CONNECTED TO THE AIRCRAFT, TO AVIOD ACCIDENTAL USAGE BY ANYBODY.

2. *Chocks should be positioned by the AIATSL staff after being instructed by the Aircraft Maintenance Personnel (AMP) on headset.*
3. *The AMP on headset should give clearance to the cockpit crew for releasing brakes.*
4. *After being instructed by the Aircraft Maintenance Personnel of AIESL, the safety cones should be placed around the aircraft.*

NOTE:

NORMALLY THE GROUND TO COCKPIT COMMUNICATION IS THROUGH THE AIRCRAFT INTERPHONE. HOWEVER, DURING THUNDERSTORM/ NEAR THUNDERSTORM AS USE OF HEADSET IS HAZARDOUS, HAND SIGNALS ARE USED INSTEAD.

NOTE:

FOR ALL AIRCRAFT IN CASE OF ABNORMAL CONDITIONS LIKE EXCESSIVE SLOPE ON RAMP OR STRONG WIND CONDITONS, ADDITIONAL CHOCKS MAY BE REQUIRED TO BE POSITIONED AS WARRANTED BY THE CONDITION.

Procedure for Removal of the Safety Cones Around the Aircraft before Departure and Installation and Removal of Chocks on Aircraft before and after Pushback in Chhatrapati Shivaji International Airport, Mumbai

1. *BEFORE connecting the tow bar to the tow tractor, the Aircraft Maintenance Personnel (AMP) on headset should ensure that all ground equipment are cleared off the aircraft, Aerobridge / passenger step ladders are moved away from the aircraft, parking brake is ON and all panels and doors of the aircraft are closed.*
2. *After being instructed by the AMP on headset, the safety cones should be removed by the AIATSL staff.*

3. *Prior to giving clearance for pushback to the cockpit crew, the Aircraft Maintenance Personnel (AMP) on headset should check that the steering lockout pin is installed properly as mentioned in the respective AMM, the tow bar is connected properly at the aircraft and the tractor ends, the area in and around the nose wheels of the aircraft, tractor and below the aircraft is clear off personnel; check for any moving / static vehicle or another aircraft, get request for pushback from the cockpit crew and ensure that two wingtip watchers are positioned.*
4. *The AMP on headset should check before the commencement of the pushback, that on the Aircraft, ready for departure, chocks are on, the aircraft is held by parking brakes, tractor / tow bar connected and the tow tractor operator has confirmed that tractor parking brakes are 'ON'.*

WARNINGS

A. TO AVOID AIRCRAFT WHEELS OR TRACTOR RUNNING OVER PERSONNEL DURING PUSHBACK OF AIRCRAFT, NOBODY SHOULD BE ALLOWED TO WALK NEAR MAIN WHEELS OR AFT OF NOSE WHEELS OR CLOSE TO THE TRACTOR. ALL SHOULD WALK ON THE LEFT SIDE OF AIRCRAFT NOSE, WHILE MAINTAINING MINIMUM 10 FEET BETWEEN NOSE WHEEL, THE TRACTOR AND PERSON. NOBODY SHOULD BE ALLOWED TO CROSS OVER TOW BAR WHILE PUSH BACK IS ON.

B. TO AVOID DISENGAGEMENT OF STEERING PIN RESULTING IN VIOLENT SWING OF THE TOWBAR AND INJURING PERSONNEL, THE AIRCRAFT MAINTENANCE PERSONNEL ON THE HEADSET SHOULD CHECK FOR THE PROPER ENGAGEMENT OF STEERING PIN PRIOR TO COMMENCING PUSH BACK.

C. TO AVOID INTERPHONE CHORD ENTANGLING MOVING NOSE WHEEL, LEADING TO PERSONS BEING RUNOVER BY NOSE WHEELS, THE AIRCRAFT MAINTENANCE PERSONNEL ON THE HEADSET MUST HOLD THE CORD IN SERIES OF LOOPS IN HAND WHILE MAINTAINING THE MINIMUM 10 FEET AS ABOVE.

D. TO AVOID PERSONNEL BEING SUCKED INTO OPERATING ENGINES OR BLOWN UP BY HIGH VELOCITY EXHAUST GASES, EVERYBODY ASSOCIATED WITH PUSHBACK MUST OBSERVE THE PRECAUTIONS FOR THE INTAKE AND EXHAUST DANGER ZONES.

5. *Upon receiving PUSHBACK CLEARANCE from ATC, the following procedure should be followed.*
 - i. *Cockpit crew to AMP on headset: "AIRCRAFT CLEAR FOR PUSHBACK "FACING _____"(i.e. the direction of aircraft nose should face after pushback)*
 - ii. *The AMP on headset should instruct the AIATSL staff to remove chocks, and after removal,*
 - iii. *AMP on headset to Cockpit Crew: "RELEASE BRAKES"*
 - iv. *Cockpit crew to AMP on headset: "BRAKES RELEASED"*
 - v. *AMP on headset should give thumbs up signal to the tractor operator signifying clearance for push back and should also signal him the direction the aircraft nose should face after pushback*
 - vi. *AMP on headset to cockpit crew: "PARKING BRAKE RELEASED COMMENCING PUSHBACK"*

6. Upon reaching the final position, the AMP in headset should confirm it from the Cockpit crew. He should ensure that the aircraft is stationary and the nose wheel is straight.
7. The AMP on headset should Inform cockpit crew, "PUSH BACK COMPLETED SET PARKING BRAKE ON" On receipt of the confirmation from the cockpit crew, "BRAKE ON, PRESSURE CHECKED", he should ensure parking brake light is ON. On his instruction, the AIATSL staff should install nose wheel chocks and confirm it to the AMP on headset.
8. The AIATSL staff should disconnect the tow tractor, followed by tow bar.
9. After the tow bar has been removed away from the nose wheels, the nose wheel steering deactivation pin should be removed by the AIATSL staff and same should be confirmed to the AMP on headset.

CAUTION:

THE STEERING LOCKOUT PIN SHOULD BE REMOVED ONLY AFTER THE TOWBAR IS DISCONNECTED AND CLEARED OFF THE NOSE WHEELS.

10. After engines are started, on instruction of the AMP on headset, the AIATSL staff should remove the chocks from the nose wheel.
11. The AMP on headset should disconnect the head phone from the aircraft receiving the instructions from the cockpit crew.
12. The AMP on headset should give the hand signal for clearance and the AIATSL personnel should display the removed nose wheel steering deactivation pin for the aircraft to taxi out, only after all the equipment and persons are cleared of the aircraft and after ensuring that there is no obstruction in the path of the aircraft.

WARNINGS

A. THE AMP ON THE HEADSET SHOULD MAKE SURE THAT WHEN THE AIRCRAFT MOVES WITH ITS POWER ON THE GROUND.

- i. No persons are in the vicinity where the aircraft can cause them injury.
- ii. No objects stay on any place where the engines can blow them away or can pull them into the engines by suction.

B. ALL PERSONNEL ASSOCIATED WITH THE PUSHBACK MUST OBEY THE FOLLOWING PRECAUTIONS DURING TOWING PUSH BACK OR MOVEMENT OF THE AIRCRAFT:

- i. Make sure that the path of the aircraft is clear
- ii. Make sure that no person sit or stand on the tow bar or use the tractor as transport. This is to prevent the risk of injury.

Instruction for AIATSL Staff:

1. On Arrival: Chocks and Safety Cones should be positioned by the AIATSL staff after being instructed by the Aircraft Maintenance Personnel (AMP) on headset

2. *Before pushback: After receiving the instruction from the Aircraft Maintenance Personnel (AMP) on headset, the chocks and Safety Cones should be removed.*
3. *After pushback:*
 - A. *After receiving the instruction from the Aircraft Maintenance Personnel on headset, the chocks should be installed and the same should be confirmed to the AMP on headset.*
 - B. *After the installation of the chocks, tow bar and tow tractor should be disconnected.*
 - C. *After engines are started, after receiving the instruction from the AMP on headset, the chocks should be removed from the nose wheel.*
 - D. *The removed nose wheel steering deactivation pin should be displayed to the cockpit crew before the aircraft taxiing out.”*

Unquote

1.18.5 Air India Operations Manual

As per Air India Operations manual part A Issue 4, Rev 0 dated 15-10-2014, Para 17.2 Ground Handling Arrangement and Procedures:-

Quote

“GROUND OPERATIONS

An aircraft shall not be taxied on the movement area of an airport unless the person at the controls: i) has been duly authorised and is fully competent to taxi the airplane; ii) is qualified to use the radio telephone or a person qualified to do so is on board; and

iii) has been duly briefed of the airport layout, routes, signs, markings, lights, ATC signals and instructions, phraseology and procedures and is able to confirm to the operational standards required for safe operation of the aircraft at the airport.

If, due to any reason, the aircraft has to be towed with Flight Crew manning the Flight Deck, it has to be like a normal push back procedure, with facility for communication between cockpit and ground and between cockpit and ATC being available. Further, it should also be ensured that nose wheel pin is in position.

It may also be noted that engine out taxi is in order provided the system configuration permits engine out taxi. However, exercise judgement in confined areas of airport while parking.

AIRCRAFT GROUND - HANDLING COMMUNICATIONS (GENERAL)

Ground personnel shall be in inter-phone contact with the cockpit and shall make sure that all non-essential equipment are clear of the aircraft before giving clearance to start engine. Engines shall be started only after clearance from the authorised ground personnel and ATC has been received.

SIGNALS

The Crew to adhere to the instructions given in the SOP/ Jeppesen.

MARSHALLING SIGNALS

Standard pictorial hand signals are given in the Aircraft Rules para 4, Schedule IV and ICAO Annex 2, Appendix 1. For further and on board information, refer Jeppesen Manual.

GENERAL CONDITIONS FOR PUSHBACK

PUSH BACK

Should the Captain want the A/c stopped for any reason such as ATC requirement, loss of electrical power etc., he shall advise the ground personnel on intercom to stop. Pilot shall not use the brakes for stopping during push back. Ground personnel are responsible for aircraft speed, direction control and obstacle clearance during tow/ pushback.

Nose wheel steering control must not be activated during pushback.

Flap extension/ control checks etc must not be carried out during pushback.

Prior to push back the Captain must be on inter phone contact with ground personnel. Push back shall not be done without inter phone contact between the cockpit and the ground personnel.

Push back procedure laid down in the aircraft FCOM/FCTM should be followed.

Prior to starting engines the 'Before Start' check-list must be completed.

WHEN READY FOR PUSH BACK

- Clearance for push back shall be taken from the appropriate ground/tower frequency.
- Ground personnel will advise "ready for push back" when ready to move the aircraft.
- The Captain will signal that he is ready by advising "Brakes off" for push back and advise ground personnel the specific ATC instruction of push back.

The Captain's signal means:

- i) The Marshaller is in sight
- ii) ATC clearances has been received to leave gate
- iii) The brakes have been released.

Should the Captain want the aircraft stopped for any reason such as request from ground control, loss of external power etc. he shall advise the ground personnel by interphone to "stop" the aircraft. Pilot shall not use the brakes for stopping during push back. Ground personnel are responsible for aircraft speed, direction, control and obstacle clearance while the aircraft is being towed/pushed backed.

- Hydraulic/electrical power configuration before push back shall be as per aircraft FCOM/FCTM.

- No power/hydraulic conditions will be altered during push back.
- Nose wheel steering control must not be activated during push back because the steering mechanism can be damaged.
- When push back is completed, ground personnel will advise “Brake ON”, after the brakes are set the flight crew will advise ground personnel ‘Brakes ON’.

PUSH BACK, START UP AND TAXI OUT

It is an acknowledged fact in the industry that pushback and engine start is a hazardous procedure. Misunderstandings between the cockpit and ground crew can lead to serious accidents, injury to personnel or damage to aircraft or equipment. All personnel involved in the operation have to be extremely vigilant at all times and strictly adhere to the procedure.

- Clearance for pushback shall be taken from the appropriate ground/ tower frequency.
- After completion of before start checklist:
 - o Captain asks the ground “Confirm A/c clear, all doors Closed.”
 - o Ground checks and replies “A/c clear all Doors Closed.”.
 - o Captain: “Clear to pushback facing.....”
 - o Ground: “Pushback facing..... Release parking brakes.”
 - o Captain: “Parking brakes released.”
 - o Ground: “Commencing pushback”

If engine starting is authorised during pushback by the ATC and by the ground personnel, engine start up may be accomplished as per the procedure in the FCOM and SOP. If one engine is started in the bay and for starting remaining engines, requires the running engine to be run up above idle to increase duct pressure, the remaining engine(s) should be started only after completing pushback. Engine should not be operated above idle during pushback.

DELAYS IN PUSHBACK / POST PUSHBACK

In case there is any problem and the tractor has not been disconnected, the ground personnel will indicate to the cockpit crew as follows: “Standby, tractor NOT disconnected....” etc.

ENGINE START WHERE NO PUSHBACK REQUIRED

In this case it must be ensured that chocks are in place and parking brakes are applied prior to engine start up. Communication with the ground personnel will be carried out as given in respective FCOM/ SOP.

ONE ENGINE STARTUP AT BAY

At times due to unserviceability of APU, one engine may be started in the bay. Appropriate clearances must be obtained from ATC and ground personnel. Engine should be started in accordance with respective FCOM/ SOP. Remaining engine(s) should be started on completion of pushback to avoid stress on the tractor and tow bar.

ALL ENGINE STARTUP AT BAY

It is general policy of the company that not more than one engine start shall be accomplished at bay prior to pushback. However only and if only ATC requires specifically for aircraft to complete all engine start at bay for purposes of congestion and sequencing of taxi lane, the pilot is permitted by company to accomplish all engine start at bay prior to pushback.

PRIOR TO TAXI

The Captain must not release parking brakes until the mechanic/ marshaller has given thumbs up signal on the left/ right side, after start checklist is completed and ATC clearance has been obtained.

All actions must be deliberate and unhurried. There should be no hurry to taxi out. It must be ensured that the ground crew has moved away well clear and thumbs up signal has been obtained. The ground crew on their part must constantly inform the cockpit crew of all the things that are happening down below as an extensive portion below the nose is not visible from the cockpit. If any operation such as disconnecting tow bar etc. is interrupted or delayed, the ground crew must call up on the intercom and inform the Captain. In case of no communication with the ground crew for a reasonable period of time the cockpit crew should also make all attempts to re-establish communication by sounding the horn etc. If there is still no response from the ground, the ground/ apron control should be contacted on R/T. Avoid using ambiguous terminology.

One person from the ground crew must be designated as marshaller and give thumbs up signal, or at night with marshalling flash light wand and wait till the aircraft taxies out.

GUIDANCE ON TAXIING AN AEROPLANE

Before commencing taxi, ensure that taxi instructions are clearly understood by both pilots and the taxi routing is discussed. If in doubt, ask ATC again and note down. Utmost caution and vigilance must be exercised during taxi. No paperwork, putting away charts, unnecessary conversation etc. should be carried out during taxi. Taxi speed should be adjusted to suit conditions and neither be excessive nor too slow at any time. Avoid coarse use of nose wheel steering and brakes in order to provide passengers a comfortable ride.

WEARING OF HIGH VISIBILITY JACKETS IN OPERATIONAL AREAS

It is mandatory for all personnel working in the operational areas of the airport to wear High Visibility Fluorescent Jackets.”

Unquote

The deceased Senior Service Engineer was wearing high visibility Jacket.

1.18.6 Operation of A320 family (A319, A320 and A321) in same Duty Cycle.

DGCA has issued Operations Circular No. 4 of 2006 “Same day Operations of variants of A 320 Family” vide file No. AV.22012/65/2005-FID dated 21st November, 2006. The circular are advisory in nature. As per circular, pilots who are type rated to fly A 320 variants (A 318, A 319, A 319 CJ, A 320 and A 321) endorsed on their license shall be allowed to fly the variants on same day/ duty cycle provided they meet the following requirements:

1. Minimum experience on A 320 family is not less than 300 hours and not less than 50 Hrs. on each variant of A-320 family as Captain or First Officer (in respective capacity).
2. Before exercising privileges on the variants of A-320 family on the same day, pilots flying a second variant on the same day for the first time shall undergo a successful route check on the second variant.
3. Pilots shall not fly more than two variants on same day.

CFOI, DGCA letter No. AV.22012/65/2005-FID dated 8th July 2008 allows Air India to operate A 320 family aircraft with lesser experience as specified in Circular 4 of 2006. The letter states “*It has been decided permit your Pilots authorized with A 320 family with a minimum of 150 hours experience on any variant of the A320 family to fly/be checked out/ do SLF on all variants. However for the first to accomplish this, the Pilot to fly the other variant, shall undergo a familiarization Flight on the route with DGCA approved Training captain*”.

As per, Air India Operations Manual Part-D Issue -2 dated 15-10-2014, para 1.1.1.2 pt. (m), Training for Pilots possessing A-320 type rating less than 500 hrs of experience “with minimum of 150 hrs. of experience on any variant of A 320 family, a pilot can fly not more than 2 variants of family on the same day subject to undergoing a successful route check on 2nd variant”.

Airbus vide e mail dated 06-01-2016 forwarded Operational Suitability data (OSD) Flight Crew A 320 report to Air India. As per the report all A320 family models are assigned a single license endorsement and recurrent training performed on any A320 family aircraft is valid for all variants provided that the difference identified are addressed.

CFOI, DGCA letter No. AV.22012/65/2005-FID (Pt.) dated 15th March 2016 allows Air India to operate A320 family aircraft without any route check or experience. The letter states “*approval is hereby granted for pilots to operate two variants of A320 aircraft on the same day, without a Route Check. The experience level stipulation in DGCA letter No. AV. 22012/65/2005-FID dated 08.7.2008 and Operations Circular 04 of 2006 shall not be applicable*”.

The same was incorporated in Air India Operations Manual Part-D Issue -2 Rev 8 dated 15-03-2016.

The co-pilot has 86 hours on Airbus family.

1.18.7. Supervised Line Flying (SLF).

Supervised line flying (SLF) is operating experience/flying done by a type rated flight crew member under supervision of a Check Pilot/Examiner/LTC/TRI for the purpose of acquiring the specified experience prior to undertaking line operations which are unsupervised by a Check Pilot/Examiner/LTC/TRI. SLF forms part of training syllabus and may be specified in terms of experience of flying hours or sectors by an operator.

As per CAR Section -8, Series F part II dated 30th April 2013, the Supervised line flying (SLF) is operating experience/flying done by a type rated flight crew member under supervision of a Check Pilot/Examiner/LTC/TRI for the purpose of acquiring the specified experience prior to undertaking line operations which are unsupervised by a Check Pilot/Examiner/LTC/TRI. SLF forms part of the training syllabus and may be specified in terms of experience of flying hours or sectors by an operator.

As per CAR, the Co-pilot line training and checks includes:-

- (a) Route check for release to undergo SLF.
- (b) Conduct the first 4 sectors of SLF in the aeroplane under the supervision of an LTC/TRI occupying LHS and complete a minimum of;
 - (i) 30 sectors SLF if flying experience is less than 1000 hours on commercial transport aeroplanes.
 - (ii) 15 sectors SLF if flying experience is more than 1000 hours on commercial transport aeroplanes.
 - (iii) An operator may specify a proportion of sectors above to be performed as PM depending on the experience level and type of operations.
- (c) Operator's line release route check combined with line route check.

As per Air India has Ops Manual Part D Section -1 Chapter -1 Issue -2 dated 15th October 2014 training requirements for pilots possessing A-320 Type Rating with less than 500 hrs of Experience , the SLF training is of 60 Sectors and divided in two phases.

Phase-I 25 Sectors with Instructor/Examiner

Phase -II 35 Sectors with Check pilot

As per record submitted by Air India, Co-Pilot had carried out first officer release check on 10/11/2015 and started SLF training from 11/11/2015. Till the date of accident co-pilot had carried out 47 Sectors.

1.18.8 Flight Planning & Crew Scheduling:-

The cockpit crew (PIC & Co-pilot) was scheduled to operate Mumbai- Rajkot-Mumbai on A 320 aircraft VT-ESI and Mumbai- Hyderabad –Mumbai on A 319 aircraft.. The flight details are

Mumbai – Rajkot Flight No. AI 655 scheduled time of departure (STD) was 11:35 UTC and the return flight Rajkot- Mumbai AI 656 expected time of arrival (ETA) was 14:40 UTC. However the flight AI 655 departed from Mumbai at 11:55 UTC and landed at Rajkot at 13:00

UTC. Return flight AI 656 departed from Rajkot at 13:30 UTC and landed at Mumbai at 14:55 UTC. The aircraft reached Bay V30R at 15:05 UTC.

AI 619 (Mumbai-Hyderabad) ATD was 14:00 UTC which was further delayed to due late arrival of AI - 656. Thereafter both cockpit crew got down from the aircraft and rushed to Bay V28L by jeep to operate AI-619 VT-SCQ. The aircraft VT-SCQ had earlier operated flight AI 618 (Hyderabad- Mumbai) and was parked at Bay V28L at 13:09 UTC.

Perusal of Log book of PIC & Co-pilot reveals that the combination had operated aircraft (A321 & A 319) at Delhi on 19-11-2015 & 08-12-2015. The time taken to change aircraft was 09 & 23 minutes respectively. The co-pilot had not operated A320 and A319 on same duty cycle during SLF training.

1.18.9 Recording of Cockpit Communication in CVR

As per Air India A 319 FCOM, the cockpit voice recorder (CVR) records:-

- Direct conversations between crew members in the cockpit
- All aural warning sounded in the cockpit.
- Audio communications received and transmitted
- Intercommunications conversations between crew members
- Announcements transmitted over the passenger address system, if PA reception is selected on at least one audio control panel.
- The Cockpit Voice Recorder retains last 2 hours of recordings.

The CVR system consists of :-

- A remote microphone behind the overhead panel
- A “hot mike” function, which records the crew members voice directly from their microphone, even if the push to talk switch is not activated.
- A crash proof four-track recorder, equipped with an underwater locating beacon, in the aft section of the aircraft.
- A control panel on the overhead panel.

CVR energized automatically:-

- On the ground during the first 5 min after the aircraft electrical network is energized
- On the ground with one engine running
- In flight

On the ground, it is stopped automatically 5 min after the last engine shutdown provided the CVR jack is not used.

If required the crew on the ground can energize the CVR manually by pressing the GND CTL pushbutton.

The SOD pilot's communication with ATC was not recorded in CVR. However, their communication was recorded in ATC (Delivery)

1.18.10 Pilot Reporting of Crew for Duty.

As per Air India Operations manual part A Issue 4, Rev 0 dated 15-10-2014, Para 17.1.0.2.1

Quote

“Reporting Time”

Flight Crew duty time will commence from the time he reports at the airport for the purpose of operating a flight.

For Practice & Test Flights: 45 minutes before the flight.

Entry into the aircraft:

- a) The crew must board the aircraft at least 30 minutes (B777/B787/B744/A330) /20 minutes (A320 family) prior to scheduled time of departure.
- b) For ultra-long haul, 45 mins before the scheduled time of departure.

Entry of reporting timings: Reporting time at Movement Control/Flight Despatch should be entered on the Pilots Report and Crew Reporting form/ pre-flight register).

As per Air India Operations manual part A Issue 4, Rev 0 dated 15-10-2014, Part 2.8.1

Pre-flight Reporting Time: For International Flights Minimum 60 minutes and for Domestic and Neighbouring Countries Minimum 45 minutes.

As per Air India Operations manual part A Issue 4, Rev 0 dated 15-10-2014, Para 1.22

Rerecording of Departure Time / Delays In order to ensure uniformity and accuracy, the following procedure will be adopted by all concerned in reporting delays in the departures of our flights: For ‘On Time’ Departure, the doors will be closed at 10 minutes before the scheduled time of departure i.e. D-10. This cushion of 10 minutes is intended to cover push-back, starting of engines, obtaining ATC Clearance etc. and if the aircraft moves within this time, no delay will be logged, as the aircraft would have left on schedule. If, however, the doors are closed later than 10 minutes before scheduled departure time, or if the departure is delayed after the doors are closed for any reason, the nature of delay will be recorded accurately in the Pilot’s report, giving details. In stations where push back is involved before taxiing the aircraft, the departure time will be noted at the time when the aircraft is taxied out on its own power. Any delay to the extent of time taken for push back from 10 minutes after the closure of the door till the time the aircraft taxis out on its own power will be indicated as delay due push back.”

Unquote

In the present case as per CVR and ATC Transcript, Pilot & Co-pilot reported for duty in the cockpit of AI 619 at 07 minutes before pushback. They didn’t physically report to Dispatch for pre briefing and contacted dispatch over RT for the same while operating flight Rajkot-Mumbai.

1.18.11 DGCA Circular to Mitigate Flight Delay

DGCA has issued Air Transport Circular 2 of 2013 dated 30-05-2013 on “*Procedure to be followed to mitigate flight delays*”. The circular are advisory in nature. The circular laid down procedure for enforcement of the flight schedules. As per circular

- *Aircraft shall contact Clearance Delivery Unit (CLD) for ATC clearance not more than 45 minutes prior to scheduled time of departure and not later than 15 minutes prior to scheduled time of departure.*
- *Aircraft shall contact Surface Movement Control (SMC) for pushback and start up at least 15 minutes prior to schedule time of departure.*
- *Approval for push back and start up shall be valid for five minutes only. Aircraft not adhering to pushback clearance will go back in the sequence. Subsequent clearance will be given based on available slot.*

In the present case, the SOD pilot has obtained clearance from ATC at 14:58: 33 UTC as the crew was operating Rajkot- Mumbai flight.

As per records, the flight AI 619 whose departure was 14:00 UTC was re-scheduled to 15:30 UTC at 14:26 UTC . The passenger boarding started at 14:47 UTC and closed at 15:09 UTC. Aircraft doors closed at 15:13 UTC.

1.18.12 Draft DGCA Circular on Airside safety procedure for Ground Handling Operations at Airports

DGCA has issued a Draft Aerodrome Advisory Circular “Airside safety procedure for Ground Handling Operations at Airports” on 08/12/2010 for public comments. The circular give detailed procedure for safe ground handling. However, the final circular was not issued.

1.18.13 Co-Pilot Training

The co-pilot had carried out following training.

- Flying training for issue of CPL during year 2007 at Falcon Aviation Academy, Newnan, Georgia, USA. The CPL was issued by DGCA on 25-06-2008.
- A-320 training at FSB Flugschule Berlin GmbH in year 2011 and A-320 co-pilot rating was issued by DGCA on 27-07-2011.
- Simulator training at Egypt Air Aviation Training (Egyptian Holding Company) in year 2014

The copilot was selected in Senior Trainee Pilot Batch-2 in year 2015 and reported CTE on 15-06-2015. He had carried out following training

- FFS Session, IR/PPC, SO Checks and F/O Check carried out at Air India is as under
 - i. FFS -1 on 25th July 2015
 - ii. FFS-2 on 26th July 2015
 - iii. FFS-3 on 27th July 2015
 - iv. FFS-4 on 31st July 2015

- v. IR/PPC on 2nd August 2015
- vi. A-319/A-321 Endorsement by DGCA on 17th August 2015.
- vii. Familiarization flight on A319 on 22/08/2015

However, the logbook entries regarding Simulator Hours had error. The copilot had carried out Simulator for 20 hours at CTE, but the total on logbook shows 40 hours. Also, two different dates were mentioned on CRM Training certificate issued by CTE.

After completion of training at CTE, copilot reported for supernumery flying at Mumbai on 13-08-2015. The first officer release check was carried out on 10-11-2015 and SLF training started with PIC on 11-11-2015.

1.18.14 Reconstruction of sequence of accident

On 28-01-2016, the accident investigation committee visited Mumbai and reconstruction of sequence of accident was constructed using Airbus A319 at Bay No. 28 & 29, CSIA Airport at night. During the reconstruction, the engines were not switched ON and the pushback was carried out using the tow tractor. The involved personnel were also called for construction of sequence of events. Following are the salient observations:-

- (i) The surrounding area was visible however the ambient light was not enough to view the thumb signal of AMP from cockpit without the help of torch light.
- (ii) Movement of Tow tractor and person was visible from the cockpit.

1.18.15 Shift Duties by Deceased Senior Service Engineer and AME

- (i) The deceased senior service engineer was available on IInd shift (1330 IST to 2130 IST). The last 06 days duty schedule is as under

Date	Shift	Timings
10/12/2015	III (RNC)	2200-0700 hrs IST
11/12/2015	III	2200-0700 hrs IST
12/12/2015	Night Off	
13/12/2015	Weekly Off	
14/12/2015	I	0600-1400 hrs IST
15/12/2015	I	0600-1400 hrs IST
16/12/2015	II	1330-2130 hrs IST

RNC- Reported not coming

The deceased senior service engineer was allotted 03 aircrafts in the shift. Prior to the accident, the deceased had carried out one aircraft pushback.

- (ii) The AME was available on IInd shift (1330 IST to 2130 IST). The last 06 days duty schedule is as under

Date	Shift	Timings
10/12/2015	II	1330-2130 hrs IST
11/12/2015	III	2200-0700 hrs IST + Over time
12/12/2015	Night Off	
13/12/2015	Weekly Off	

14/12/2015	Weekly Off	
15/12/2015	I	0600-1400 hrs IST
16/12/2015	II	1330-2130 hrs IST

The AME was allotted 05 aircraft in the shift. Before the accident, three aircraft were serviced by the AME.

1.18.16 Statements of Flight Crew & Ground Crew.

After the accident, officers from Air Safety Directorate, DGCA Mumbai visited the site and took the statements of those involved. One of the members of accident committee visited the accident site and collected the evidences on 17/12/2015. All the members of accident committee visited Mumbai on 28/01/2016 & 29/01/2016 for reconstruction of sequence of accident and investigation. The abstracts of statements and Question/Answers of concerned are as under.

(i) Pilot in Command.

- The PIC was scheduled to operate Mumbai-Rajkot-Mumbai & Mumbai-Hyderabad-Mumbai flight along with co-pilot who was undergoing SLF training.
- The duty roster comes 15 days in advance but changes on day to day basis and sometimes hour to hour basis to avoid delays and cancellation of flight.
- The Rajkot- Mumbai flight was delayed resulting in delay of Mumbai-Hyderabad flight.
- While in flight PIC advised dispatch regarding fueling requirements of Mumbai- Hyderabad flight and enquired about any technical snags on VT-SCQ.
- Came to aircraft from V30 R to V 28 L through jeep and carried out external inspection.
- Reached to cockpit and met SOD pilot who took clearance regarding the flight.
- Took clearance from Ground Engineer and right clearance from co-pilot regarding obstruction.
- Switch on Taxi light & moved throttle.
- Heard two thud noises and stopped the aircraft.

(ii) Co-Pilot.

- The co-pilot was scheduled to operate Mumbai-Rajkot-Mumbai & Mumbai-Hyderabad-Mumbai flight along with PIC with whom he was carrying out SLF training.
- The Rajkot- Mumbai flight was delayed resulting in delay of Mumbai- Hyderabad flight.
- Came to aircraft from V30 R to V 28 L through jeep
- Aircraft was pushed back to taxiway B4 from the bay and both the engines were started during pushback.
- Co-pilot was handling the ATC communication and PIC was handling with the Ground engineer.

- Nose wheel steering pin was disconnected by the ground personnel.
- Ground personnel confirmed on intercom and message was displayed on ECAM.
- PIC asked for the right clearance and I looked to my right clearance from the ground personnel followed by “thumbs up”.
- There was no torch used with the hand signal.
- I didn't see any tractor moving away from aircraft.
- The captain put off the parking brake & starts taxiing.
- After 06-07 seconds we heard a thud sound and stopped the aircraft.

(iii) SOD Pilot

- The Staff on Duty (SOD) pilot was flying Mumbai to Hyderabad along with his wife.
- As the operating crew was late, he entered in the cockpit and obtains ATC clearance and setup MCDU & enters squawk code.
- At that time, there was no person available in the cockpit.
- When operating crew came, he informed them regarding the same and went to his seat in cabin.
- He took clearance to prevent loss of slot time & further delay of flight.
- Later when accident occurred, PIC called him in cockpit and was in the cockpit till passenger disembarkation.

(iv) Cabin Crew In Charge (CCIC)

- The SOD pilot entered in the cockpit with Air India card displayed and at that time there was no person available in the cockpit.
- The SOD pilot went back to his seat in cabin when PIC & co-pilot arrived.
- There was an Air India engineer in the cabin who wants his seat to be upgraded.
- CCIC took his I card and shown to PIC and returned to engineer.
- As the aircraft was moving, carrying out demonstration in cabin got two jerks.

(v) Aircraft Maintenance Engineer.

- AME was allotted 05 aircraft and VT-SCQ was the fourth aircraft in the shift.
- Aircraft inspection was carried out and as the flight was delayed went to wash room & to check the arrival of fifth aircraft in the building.
- When AME came back aircraft pushback had started and the Deceased Engineer was on intercom headset.
- Along with him, was Lead Assistant & Handy Man.
- Aircraft was pushed to taxiway B4 and chocks were installed on nose wheel when stationary.
- AME stopped at Bay 29 as it was not safe to go near the aircraft watching the pushback.
- The tow bar was removed by lead assistant from Tow truck and then from aircraft.

- The steering disconnect pin & headphone connection was removed by the deceased engineer.
- Chocks were removed by the handyman & placed on tow truck.
- Both handy man and lead assistant was installing tow bar to tow Truck.
- The deceased engineer was facing back to engine with headphone on head and watching the installation of tow bar to tow truck.
- The Aircraft start moving and the technician & tow truck rushed towards the terminal.
- The tow bar hit nose wheel and RH engine suck the deceased engineer.
- The tow bar turned and hit the main wheel.
- AME ran towards the aircraft and hand -signaled the cockpit crew to stop the engine.
- AME called my foreman to get spare headset and connected the intercom headset to aircraft to brief the situation.
- All this happened without anybody giving thumbs up clearance hand signal to the cockpit crew.

(vi) Lead Assistant (Engineering helper)

- Engineering helper was allotted VT-SCQ along with deceased service engineer.
- Removed the tow bar from aircraft and going to connect to tow Truck and that time aircraft nose wheel hit tow bar.
- Engineering helper had seen that the aircraft light was ON and deceased engineer was sucked in No. 2 engine.
- Engineering helper ran to inform shift in charge and manager about the same.

(vii) Handy Man (Chocks Helper)

- The handy man puts chocks on the nose wheel after pushback.
- When instructed removed the chocks from nose wheel.
- The tow bar was removed from tow Truck and aircraft.
- When handy man and lead assistant was installing tow bar to tow Truck, the aircraft start moving.
- Handy Man and Lead Assistant ran for safety.
- The deceased technician had gone in the engine and tow bar is lying near main wheels.
- Handy man also mentioned that deceased Engineer had neither shown thumb or pin to pilot nor by any other person.

(viii) Tow Truck Driver

- The aircraft pushback was carried out from V 28L and during pushback the one engine was started.
- The handy man puts chocks on the nose wheel after pushback.

- The tow bar was removed from tow Truck and aircraft by the engineering helper.
- Tow Truck Driver had reversed the tow Truck and turned so the tow bar could be connected.
- Suddenly in rear view mirror Tow Truck Driver saw aircraft coming near the tow Truck, so Tow Truck Driver moved the tow Truck.
- Tow Truck Driver saw Handy Man and Lead Assistant running.
- Tow Truck driver also mentioned that deceased Engineer had neither shown thumb or pin to pilot nor by any other person.

1.18.17 CCTV recording from the Apron Camera installed at Bay 29.

MIAL has submitted the CCTV recording of the event from the camera installed at Bay No. 29. The camera is installed to view the apron activity. However, as the Taxiway B4 was far, a faded video of the accident site was submitted to committee. Following are the salient observation.

- At the time of Pushback there were 04 persons i.e. deceased Service Engineer, Engineering Helper (lead Assistant), handyman (Chocks helper) and Tow Truck operator was near the aircraft.
- **As the video is very faded** it is recognized that following action was carried out at B4 Taxiway.
 - One person was seen standing far from the aircraft on the right side observing the pushback (AME).
 - Engineering helper removed Tow bar from Tow Truck and then from aircraft.
 - The chocks helper had removed chocks from nose wheel of aircraft and kept on tow Trucks.
 - The tow Truck moved back a little and then turned left so that tow bar can be attached to tow Truck. Flashing light was seen on the top of tow Truck.
 - Both Engineering helper & chocks helper moved near the tow Truck to attach tow bar.
 - The deceased service Engineer was standing near the nose of aircraft.
 - Taxi light was switched on and aircraft started moving.
 - Tow Truck moves towards building.
 - Engineering helper & chocks helper ran towards building.
 - As the aircraft moves sparks were observed from the exhaust of RH engine.
 - Aircraft stopped after around 5 sec after moving a little forward.

1.18.18 Safety Risk Assessment on Push back Procedure

Air India had carried out Safety Risk Assessment meeting on Push back Procedure on 30th December 2015. The salient points of the meeting are:-

Quote

*“1. **Safety Cones:** It was decided that number of safety cones for Air India Fleet of B787/B777/A320/A321 would be six. For B747, it would be eight.*

2. **Chocks:** For all Air India Fleet number of Chokes would be SIX. Positioning of Chocks would be as per the procedures provided by Engg. For conditions when the winds are above 25Km/hr. all the wheels of the Aircraft would be choked.

3. During push back operations, the Engines would be started only after the push back is complete and the Aircraft is stationary and positioned at the Taxiway (Tug disconnection point) **Except** for Airports where the ATC requires the engines to be started during the push back or in the bay.

4. When the APU is U/S, one engine may be started at the bay and thereafter after the completion of the push back the other engine cross start may be carried out at the taxiway (Tug Disconnection point).

5. It was also decided that the Ground personnel who are involved in the final clearance of the Aircraft may stand at 45 Degrees on the left or Right to the Aircraft Nose instead of 90 degrees as practiced up till now. This would increase the visibility of the Ground personnel to both P1 and P2. Precautions may be taken in this regard when there is a sharp left or Right turn just at the start of the Taxi of the Aircraft.

6. There seemed to be lack of clarity on the number of personnel to be available for push back operations/ final clearance of the Aircraft, as it is not clearly documented. After lot of discussion, it was agreed that at least two personnel are from GSD (AIATSL/AISATS) where one is the operator of push back and one helper. Two personnel are from Engg (AIESL) where one is Aircraft Maintenance personnel (AMP) who is on head set and the other is the helper (Assistant). They are not always dedicated for the flight departures.

a). Hence it was also agreed that in future there has to be a Ramp Supervisor who is responsible and accountable for all the under the wing operations. While the turn around coordinator is also required who is accountable for the entire ground operations (above and below the wing), the Ramp Supervisor is primarily a trained ground person responsible for under the wing activity. At present, in Narrow Body the commercial staff were carrying out the function of supervising the loading and unloading and were not supervising the entire under the wing operation.

b). Ramp supervisors shall be responsible for all jobs on tarmac under the wing which includes loading/unloading, positioning of safety cones and chocks and final push back and clearance. In this regard it was decided that the eligibility qualifications and training syllabus for Ramp supervisors shall be provided to Flight safety for review. The provisioning of Ramp supervisors who shall be wearing High visibility jackets with Ramp supervisor written on it shall be done by AIATSL/ AISATS. Further the duties and responsibilities of the Ramp Supervisor should be clearly specified in the Ground Handling Manual as well as the AIATSL/ AISATS manual. The Engg. would be provided the telephone numbers of the shift in charge of GH for any deficiencies observed with regard to cones / chokes etc. For a given flight, they would contact the Ramp supervisor for any issues pertaining to the flight.

Marshallers shall be nominated by the GH and they shall be giving the final clearances after obtaining the same from Engg and ensuring that all SOPs are compiled. This process shall standardise our procedures as per International norms.

AIATSL representatives stated that would need some time to augment the manpower and complete the training for Ramp Supervisors and Marshallers and it was agreed that they would provide a time line for the same.

7. After the Aircraft is positioned at the taxiway (Tug Disconnection point) for Engine start two chokes would be positioned at the Nose wheel before the Engine start for Airbus Fleet. The process shall be carried out by Engg and AIATSL as of now, till the function of providing and placing chocks is taken over by the AIATSL, due inadequate manpower. Boeing fleet shall continue this process with one chock. This decision was taken only for Airbus fleet, as per inputs received from Engg. and Operations as this was the existing SOP earlier when Engg. was carrying out the task. Also, since the distance from the nose to the engine in an Airbus aircraft is lesser than a Wide Body aircraft, it was felt that it was safer to have two chokes instead of one, to be implemented immediately, which can be reviewed after a period of three months.

8. After the successful start of both engines and the removal of tow bar and the head set from the Aircraft, the AMP and the Assistant shall position themselves at 45 degrees of the nose on the left or right as the case may be. Final clearance shall be given by the AMP only to the cockpit crew by baton (daytime) and marshalling torch in night.

It is reiterated again that as of now AMP (Engg) only shall be giving the final clearance to the Aircraft by the way of showing the pin and by baton(daytime) and marshalling light at night. For future, the SOP would be developed wherein the Marshallers as provided by Ground handling will be given the final clearance, after obtaining the necessary clearance from AMP.

9. Wing walkers are introduced at Delhi/ Bangalore and a few more stations. In future the wing walkers shall be introduced for all arrivals and departures to alleviate the possibility of any Ground incidents during Arrivals/ Departures at the Bays at all major Airports.

10. Engineering shall initiate a process to give high visibility jackets to its personnel which shall have ENGG written on it so that can be identified by crew and others on the tarmac.

11. The Operations Manual would be amended to include a para on cross check between PIC and First Officer to ensure that both confirm that they have received the final clearance from the ground before taxiing.

12. Seeing the variation of SOP between Wide Body and Narrow Body, it was agreed that there has to be a final standardisation of SOP. For both Engg. and Ground Handling, it was agreed by consensus, that the Wide Body SOP would be gradually adopted by the narrow body also for consistency of SOP.

13. Engg. Department/ AIESL need to review their documentation on requirement of AME for push back procedures. Whatever is documented has to be implemented also. In case, internally it is assessed by Engg. that a Service Engineer can also do the task then he has to be

appropriately trained and the manuals need to be amended accordingly. The syllabus needs to be provided to Flight Safety. However in case it is assessed internally by Engg. that AME is required, then it is essential that AME's are positioned for these push back related activities. Engg. to provide their internal safety risk assessment to Flight Safety."

Unquote

1.19 Useful or effective investigation techniques: NIL

2. ANALYSIS

2.1 SERVICEABILITY OF THE AIRCRAFT

Airbus A 319 aircraft VT-SCQ (MSN 3918) was manufactured in year May 2009. On the day of accident, the aircraft had logged 16559:24 airframe hours and 11721 cycles and was holding a valid certificate of airworthiness and flight release prior to flight. The Air India was having valid Air Operator Permit (AOP).

The aircraft and engines were being maintained under continuous maintenance as per approved maintenance program consisting of calendar period based maintenance and flying hours /cycles based maintenance.

The last major inspection 2420 days was carried out at 16427:36 hours/11612 cycles on 27/11/2015.

The load and trim sheet was prepared before flight and c.g. of the aircraft was within the operating limits. There was no snag reported on the aircraft prior to the accident flight.

The distance between aircraft nose & Engine for A 319 is 9.6 meters whereas for A 320 is 11.19 meters which is to be taken into account while cross utilizing two different type of aircraft.

2.2 WEATHER:

At the time 1500 UTC, the visibility was 2500 meters, winds 360/06 kts, temp 26.2°, Dew point 17.1 QFE 1011.2 hPa & QNH 1012.0 hPa.

2.3 ANALYSIS OF FLIGHT DATA RECORDERS & ATC CONVERSATIONS

The data from CVR, DFDR and ATC tape was analysed and following are the salient findings

- a) SOD pilot contacted ATC at 14:58:18 UTC for clearance of AI 619.
- b) The operating crew reached cockpit at 15:08:05 UTC.
- c) At 15:14:26 UTC parking brake were released and pushback commenced at 15:15:10 UTC.
- d) While pushback, No. # 2 engine was started at 15:16:02 UTC and No. # 1 engine was started at 15:16:54 UTC.

- e) Parking brake was set at 15:17:30 UTC when aircraft reached at Taxiway B4 and PIC asked deceased Ground Service Engineer to disconnect the headset and he responded with the same.
- f) At 15:17:37 UTC, Co-pilot requested for Taxi from ATC.
- g) At 15:17:41 UTC, ATC gave Taxi clearance to AI 619.
- h) PIC confirmed with co-pilot regarding “Right Clear” for which the co-pilot responded “Right is clear”.
- i) At 15:18:06 UTC, parking brake were released.
- j) Aircraft started moving at 15:18:10 UTC with maximum ground speed recorded was 04 knots.
- k) At 15:18:22 UTC, No. #2 Engine vibrations started increasing from 0.3 and reached to maximum of 3.6.
- l) At 15:18:38 parking brakes were re-engaged.
- m) At 15:18:50 UTC No. #2 Engine was switched off and at 15:25:10 No. #1 Engine was switched off.
- n) From the DFDR data it is observed that the elapsed time of 36 secs from the moment when aircraft pushback is complete to the moment aircraft commences taxi.

2.4 DGCA CIRCULARS

DGCA has issued circulars which are advisory in nature.

- a) DGCA Operations Circular No. 4 of 2006 “Same day Operations of variants of A 320 Family” dated 21st November, 2006 mentions the minimum requirements for operations of A 320 variants (A 318, A 319, A 319 CJ, A 320 and A 321) in same duty cycle. As per circular minimum experience on A 320 family is not less than 300 hours and not less than 50 Hrs. on each variant of A-320 family as Captain or First Officer (in respective capacity) & route check. DGCA letter No. AV.22012/65/2005-FID dated 8th July 2008 allows Air India to operate A 320 family aircraft with a minimum of 150 hours experience on any variant of the A320 family to fly/be checked out/ do SLF on all variants. As per, Air India Operations Manual with minimum of 150 hrs. of experience on any variant of A 320 family, a pilot can fly not more than 2 variants of family on the same day subject to undergoing a successful route check on 2nd variant”. However, the co-pilot had 86 hours on Airbus family on the date of accident. Co-pilot also operated (A321 & A 319) at Delhi on 19-11-2015 & 08-12-2015 in the same duty cycle. On 15-03-2016, CFOI, DGCA has issued a letter allowing Air India to operate two different aircraft of 320 family during same duty cycle without route check or experience.
- b) DGCA has issued Air Transport Circular 2 of 2013 dated 30-05-2013 on “*Procedure to be followed to mitigate flight delays*”. The circular laid down procedure for enforcement of the flight schedules. As per circular

- i. Aircraft shall contact Clearance Delivery Unit (CLD) for ATC clearance not more than 45 minutes prior to scheduled time of departure (STD) and not later than 15 minutes prior to scheduled time of departure.
- ii. Aircraft shall contact Surface Movement Control (SMC) for pushback and start up at least 15 minutes prior to schedule time of departure.
- iii. Approval for push back and start up shall be valid for five minutes only. Aircraft not adhering to pushback clearance will go back in the sequence. Subsequent clearance will be given based on available slot.

The circular is too restrictive. The aircraft calls clearance delivery 15 minutes before the STD and keeps the clearance alive for 15 minutes. Within a minimum five minutes before scheduled departure the aircraft must call for push-back, must receive clearance within five minutes, and commence push-back within a maximum of five minutes after receiving clearance.

2.5 FLIGHT PLANING & CREW SCHEDULING

Following are the salient observations regarding flight planning & crew scheduling:-

- i. As per PIC, the duty roster is available fortnight in advance but changes on day to day basis and sometimes hour to hour basis to avoid delays and cancellation of flight.
- ii. The Mumbai- Rajkot- Mumbai (AI 655- AI 656) & Mumbai- Hyderabad- Mumbai (AI 619- AI 0051) was operated by same cockpit crew. STA of Rajkot- Mumbai was 14:40 UTC and flight reached bay V30 R at 15:05UTC whereas, STD of Mumbai- Hyderabad flight was 14:00 UTC. There was scheduled delay of 40 minutes in flight scheduling.
- iii. As per Air India Ops Manual, the operating cockpit crew has to board the aircraft 20 minutes prior to scheduled departure for cockpit preparations and ATC clearances. However the cockpit crew in this case entered cockpit 07 minutes prior to commencement of pushback.
- iv. PIC didn't physically report to Dispatch for pre briefing of AI 619 flight and contacted dispatch over RT for the same while operating Rajkot-Mumbai flight AI 656.
- v. The Rajkot-Mumbai aircraft was A320 whereas Mumbai-Hyderabad aircraft was A319.
- vi. The copilot was undergoing SLF and was having 86 hours on A320 family.

2.6. PUSHBACK & PRIOR TO TAXI PROCEDURE

As per Air India Operations Manual the procedure "prior to taxiways" clearly mentioned that "the Captain must not release parking brakes until the mechanic/ marshaller has given thumbs up signal on the left/ right side, after start checklist is completed and ATC clearance has been obtained .

All actions must be deliberate and unhurried. There should be no hurry to taxi out. It must be ensured that the ground crew has moved away well clear and thumbs up signal has been

obtained. The ground crew on their part must constantly inform the cockpit crew of all the things that are happening down below as an extensive portion below the nose is not visible from the cockpit. If any operation such as disconnecting tow bar etc. is interrupted or delayed, the ground crew must call up on the intercom and inform the Captain. In case of no communication with the ground crew for a reasonable period of time the cockpit crew should also make all attempts to re-establish communication by sounding the horn etc. If there is still no response from the ground, the ground/ apron control should be contacted on R/T. Avoid using ambiguous terminology. One person from the ground crew must be designated as marshaller and give thumbs up signal or at night with marshalling flash light wand and wait till the aircraft taxis out”.

As per Air India Engineering Service Ltd. Staff Notice 01 of 2015

The AMP on headset should inform cockpit crew, “PUSH BACK COMPLETED SET PARKING BRAKE ON” On his instruction, the AIATSL staff should install nose wheel chocks and confirm it to the AMP on headset. The AIATSL staff should disconnect the tow tractor, followed by tow bar. After the tow bar has been removed away from the nose wheels, the nose wheel steering deactivation pin should be removed by the AIATSL staff and same should be confirmed to the AMP on headset.

As per Caution in the notice, “the steering lockout pin should be removed only after the tow bar is disconnected and cleared off the nose wheels.”

The AMP on headset should give the hand signal for clearance and the AIATSL personnel should display the removed nose wheel steering deactivation pin for the aircraft to taxi out, only after all the equipment and persons are cleared of the aircraft and after ensuring that there is no obstruction in the path of the aircraft.

As per the warning in the notice, the AMP on the headset should make sure that when the aircraft moves with its power on the ground.

- i. No persons are in the vicinity where the aircraft can cause them injury.
- ii. No objects stay on any place where the engines can blow them away or can pull them into the engines by suction.

Circumstantial evidences indicated that the relevant SOP’s at various stages as indicated above were not adhered to by the cockpit crew and the AMP for pushback and taxi were not followed.

After the accident the Air India had carried out Safety Risk Assessment meeting on 30-12-2015. The risk assessment report gives the detail procedure regarding pushback and taxing.

2.7 CIRCUMSTANCES LEADING TO THE ACCIDENT

The Scheduled Departure time of flight AI-619 (Mumbai - Hyderabad) was 14:00 UTC. The flight was delayed as the PIC & Co-pilot was operating another flight AI 656 (Rajkot-Mumbai). The Rajkot aircraft arrived at Bay V30 R on 15:05 UTC & crew rushed to V28L to operate AI 619. Another pilot flying to Hyderabad as SOD took the clearance from ATC. During Pushback Left & Right engine were started. After reaching the required position on Taxiway B4, the parking brakes were put on .The PIC asked the Ground Service Engineer to disconnect the intercom headset and he responded with the same.

However, the Tow bar & Tow truck along with other 04 ground personnel was near to the nose of aircraft. The AME attending this aircraft was away from the aircraft during departure and the deceased Ground Service Engineer was carrying out Pushback & Taxi clearance.

The PIC confirmed with co-pilot for RH side clearance of the aircraft for which the co-pilot responded affirmative. The PIC then put the parking brakes off, switch on the taxi light and gave power to taxi.

Meanwhile, the aircraft started moving and deceased Ground Service Engineer was standing with back towards the aircraft with headphone on his head viewing the installation of tow bar to tow truck. The aircraft RH engine came very close to the deceased and sucked him. All the other ground personnel ran away from the aircraft and the tow truck driver also took the tow truck away from the aircraft leaving tow bar. The nose wheel of the aircraft hit the tow bar tangentially and the tow bar was finally got stuck with the RH main landing gear wheel.

3. CONCLUSIONS:

3.1 FINDINGS:

- 1) The certificate of Airworthiness, Certificate of Registration, and CRS of the aircraft was valid on the date of accident.
- 2) The aircraft was certified and maintained in accordance with prescribed procedures. There was no evidence of defects or malfunction in the aircraft which could have contributed to the accident.
- 3) The PIC & Co-pilot had undergone the requisite pre-flight medical examination and were certified as not being under the influence of alcohol.
- 4) The CG of the aircraft was within the prescribed limits. There was no snag reported on the aircraft prior to the accident flight.
- 5) All navigation and approach aids were functional and were operating normally at the time of accident.
- 6) The PIC had a total flying hours of 18402:57 hrs of which 17144:07 hrs were on A 320 family. Co-Pilot had a total flying experience of 444 hrs and 86 hrs as P2 on A 320 family. Co-pilot was undergoing SLF flying.
- 7) As per FSD, DGCA letter & Air India Operations Manual dt.15-10-2014, minimum 150 hours & route check is required to operate 02 different aircrafts on same duty cycle.
- 8) The Cockpit crew had earlier operated Mumbai- Rajkot- Mumbai flight on A320 aircraft which reached at Bay V30 R at 15:05 UTC. The crew took jeep and rushed to bay V28 L. to operate AI 619 Mumbai- Hyderabad- Mumbai on Airbus A 319 aircraft.
- 9) The Scheduled Departure time of flight AI-619 (Mumbai - Hyderabad) was 1400 UTC. However, the ETA of Rajkot-Mumbai flight was 14:40 UTC but aircraft arrived at Bay V30 R on 15:05 UTC.

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- 10) Another Air India pilot flying to Hyderabad as SOD took the clearance, set up MCDU & entered squawk code. CCIC didn't stop SOD pilot from entering into the cockpit.
- 11) PIC & Co-pilot reached the cockpit at 15:08:05 UTC. Pushback commenced at 15:15:10 UTC and while pushback both engines were started (no #2 Engine first then #1 Engine).
- 12) After reaching the required position on Taxiway B4, the parking brakes were put on. The PIC asked the Ground Service Engineer to disconnect the intercom headset and he responded with the same. However, the tow bar and tow truck were still around the nose of aircraft.
- 13) As per AIESL Staff notice No. 01 of 2015, after the tow bar has been removed away from the nose wheels, the nose wheel steering deactivation pin should be removed by the AIATSL staff and same should be confirmed to the AMP on headset. The steering lockout pin should be removed only after the tow bar is disconnected and cleared off the nose wheels.
- 14) The PIC confirmed with co-pilot for RH side clearance of the aircraft for which the co-pilot responded affirmative. The PIC then put the parking brakes off, switch on the taxi light and gave power to taxi. However at that time all the 04 ground personnel were still around the nose of aircraft.
- 15) In the meanwhile, the aircraft started moving and deceased Ground Service Engineer was standing facing back towards the aircraft Engine with headphone on his head and viewing the tow bar installation to tow truck. The aircraft #2 engine came very close to the deceased and sucked him. The deceased Ground Service Engineer received fatal injuries.
- 16) The AME was not near the aircraft for Pushback & departure. All the other ground personnel ran away from the aircraft and the tow truck driver also took the tow truck away from the aircraft leaving tow bar.
- 17) The nose wheel of the aircraft hit the tow bar and the tow bar was finally got stuck with the RH main landing gear wheel.
- 18) As per Operations manual, the Captain must not release parking brakes until the mechanic/ marshaller has given thumbs up signal on the left/ right side, after start checklist is completed and ATC clearance has been obtained.
- 19) The pilot stopped the aircraft and switched off the RH & LH Engine. Later after around 09 minutes, AME connected the intercom headset and appraised the pilot about the situation.
- 20) As per co-pilot statement, the ground personnel had given clearance followed by thumbs up and not used torch for clearance. However, as per statement of Chocks helper & Tow truck driver, the deceased Engineer had neither shown thumb or pin to pilot nor by any other person.
- 21) As per Operations Manual One person from the ground crew must be designated as marshaller and give thumbs up signal, or at night with marshalling flash light wand.

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- 22) At the time of accident 15:18:22 UTC visibility was 2500 meters, winds 360/06 kts.
- 23) After the accident passengers were shifted to another aircraft VT-SCN at stand K4L and aircraft departed as flight AI-619 at 18:26 UTC.
- 24) DGCA has issued Air Transport Circular 2 of 2013 dated 30-05-2013 on "Procedure to be followed to mitigate flight delays" which is restrictive.
- 25) As per Air India Ops Manual, the crew must board aircraft 20 minutes prior to scheduled departure. No minimum time was mentioned, when there was change of aircraft from one bay to another bay.
- 26) The distance between aircraft nose & Engine for A 320 is 11.19 meters whereas for A 319 is 9.6 meters.
- 27) On 15-03-2016, FSD DGCA has issued a letter allowing Air India to operate two different aircraft of A320 family on same duty cycle without route check or experience. This is in contradiction to the DGCA Operations Circular 04 of 2006.
- 28) After the accident, AI had carried out Safety Risk assessment meeting on 30-12-2015 regarding pushback.

3.2 PROBABLE CAUSE OF THE ACCIDENT:

"Non-adherence to Standard Operating procedures (SOP) & delayed departure of flight due improper rostering of crew resulted in the accident."

4. SAFETY RECOMMENDATIONS :

4.1 Air India

1. Air India to issue guidelines stating that crew must board aircraft 20 minutes prior to actual scheduled departure & minimum 30 minutes of time gap should be there in case of change of aircraft between two consecutive flights.
2. Air India to review their crew rostering schedule for proper time gap and to avoid last minute changes in crew rostering.
3. Air India to issue circular to stop SOD pilot for obtaining Flight Clearances and un-authorized entry in the cockpit.
4. Air India to issue circular instructing Cabin crew not to allow entry of un- authorized person in the cockpit.
5. Air India to implement the "Safety Assessment Meeting" guidelines issued on 3rd of January 2016 at the earliest.

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5.2 DGCA

1. DGCA & Air India to review the requirement of minimum hours for cross utilization of Cockpit Crew to operate two different types of aircrafts on the same day (A320 family) during SLF training and schedule flying.
2. DGCA to review the procedure of issuance of circular, its implementation & supersedence as these circulars are advisory in nature.
3. DGCA to review the Air Transport Circular 02 of 2013 regarding mitigation of flight delay's with Airlines & Airport operators.
4. DGCA to issue circular to all Operators to follow proper SOP during Start up, pushback & taxi highlighting this accident.
5. DGCA to issue instructions to all operators that:-
 - a) Intercom headsets should only be removed by AMP after AMP is satisfied that the aircraft is clear of all equipment's & other personnel.
 - b) Both the cockpit crew to have satisfactory and clear view of thumbs up signal & steering pin by AMP/Marshaller during day and the same with torch/flash light during night.
6. DGCA to advice all scheduled Airlines, to review their crew rostering for proper time gap.
7. DGCA to advice all scheduled Airlines to issue necessary instructions to restrict the unauthorized entry in the cockpit.

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Date: 16.09.2016
Place: New Delhi