



**GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION**

**FINAL INVESTIGATION REPORT ON ACCIDENT
TO AIR INDIA AIRBUS A-320 AIRCRAFT VT-ESH
AT JAIPUR ON 05.01.2014**



**AIRCRAFT ACCIDENT INVESTIGATION BUREAU
SAFDARJUNG AIRPORT
NEW DELHI – 110003**

FOREWORD

This document has been prepared based upon the evidences collected during the investigation; discussions held with the post holders and involved personnel; replay of recorders and opinion obtained from the experts.

The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 11 of the Aircraft (Investigation of Accidents and Incidents), Rules 2012 of India.

The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this accident which may help to prevent such future accidents.

INDEX		Page No.
1.0	FACTUAL INFORMATION	2
1.1	History of Flight	2
1.2	Injuries to Persons	10
1.3	Damage to Helicopter	10
1.4	Other Damage	14
1.5	Personnel Information	15
1.5.1	Pilot-in-Command	15
1.5.2	Co-Pilot	16
1.6	Aircraft Information	17
1.7	Meteorological Information	20
1.8	Aids to Navigation	25
1.9	Communications	26
1.10	Aerodrome Information	26
1.11	Flight Recorders	28
1.11.1	Quick Access Recorder	28
1.11.2	Solid State Cockpit Voice Recorder (SSCVR)	28
1.11.3	Solid State Flight Data Recorder (SSFDR)	28
1.12	Wreckage and Impact Information	29
1.13	Medical and Pathological Information	29
1.14	Fire	30

1.15	Survival Aspects	30
1.16	Tests and Research	30
1.17	Organizational and Management Information	30
1.17.1	Air India	30
1.17.1(A)	Operational Flight Plan (OFP)	31
1.17.1(B)	Flight Dispatch – General	32
1.17.1(C)	Integrated Operations Control Centre (IOCC)	33
1.17.1(D)	Supervision & Control of the Operation	34
1.17.1(E)	Flight Dispatch (Operational Control) Manual	36
1.17.1(F)	Central Training Establishment, Hyderabad	37
1.17.1(G)	Inflight Procedure – Fuel Monitoring & Declaration of Emergency	38
1.17.1(H)	Safety Management System	39
1.17.1(I)	Emergency Response Plan	39
1.17.1(J)	Flight Planning –Fuel & Crew Compliment	40
1.17.2	Indian Meteorological Department (IMD)	41
1.18	Additional information	45
1.18.1	BEA France Report (Airbus report)	45
1.19	Useful or Effective Investigation Techniques	49
2.0	ANALYSIS	50
2.1	Airworthiness & Serviceability of aircraft	50
2.2	Flight planning, supervision & control	50

2.2.1	Role of Operations Control	50
2.2.2	Role of flight dispatch	51
2.3	Role of ATC units	52
2.4	Meteorological Aspects	53
2.4.1	Weather Conditions vis-à-vis flight progress	53
2.4.2	Regulatory requirements & Corresponding Provisions	55
2.4.3	Was available meteorological information utilised	56
2.4.4	IMD office at Jaipur	56
2.5	Flight Crew	56
2.5.1	Qualifications	56
2.5.2	Flight Planning	57
2.5.3	Training	57
2.6	Crew Resource Management (CRM)	58
2.7	SMS including ERP	58
2.8	Inflight Fuel Monitoring	58
2.9	Previous Fuel emergency	59
2.10	Sequence of events (including DFDR & CVR analysis)	59
3.0	CONCLUSIONS	62
3.1	FINDINGS	62
3.1.1	General	63
3.1.2	Organizational influences	64

3.1.3	Unsafe supervision	65
3.1.4	Preconditions for unsafe acts	65
3.1.5	The accident	66
3.2	PROBABLE CAUSE	68
4.0	SAFETY RECOMMENDATIONS	69

GLOSSARY

AAI	Airport Authority of India
AAIB	Aircraft Accident Investigation Bureau
ACARS	Aircraft Communications Addressing and Reporting System
ACC	Area Control Centre
AGL	Above Ground Level
AIC	Aeronautical Information Circular
AIP	Aeronautical Information Publication
AIREP	Air Report
ANSP	Air Navigation Service Provider
AP	Auto Pilot
ATC	Air Traffic Controller
ATIS	Automatic Terminal Information Service
ATPL	Air Transport Pilot License
ATS	Air Transport Service
BA	Breath Analyser
BEA	Bureau d' Enquetes et d' Analyses (France)
CAR	Civil Aviation Requirement
CAT	Clear Air Turbulence/ Category
CG	Centre of Gravity

CMV	Converted Meteorological Visibility
CRM	Crew Resource Management
CTE	Central Training Establishment
DGCA	Directorate General of Civil Aviation
DME	Distance Measuring Equipment
ERP	Emergency Response Plan
FDAU	Flight Data Acquisition Unit
FIC	Flight Information Centre
FMS	Flight Management System
FOQA	Flight Operations Quality Assurance
FWZ	Flug Werk Zeuge
FWZ CFP	FWz Computerised Flight Plan
HF	High Frequency
HHDLU	Handheld Download Unit
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IMD	India Meteorological Department
IOCC	Integrated Operation Control Centre
IST	Indian Standard Time
KTS	Knots

L/G	Landing Gear
LATG	Lateral Acceleration
MDA	Minimum Decision Altitude
MET	Meteorology
METAR	Format for reporting weather information
MI	Medical Inspection
MWO	Meteorological Watch Office
NAL	National Aerospace Laboratories
NOTAM	Notice to Airmen
OPF	Operational Flight Plan
PF	Pilot Flying
PFR	Post Flight Report
PIC	Pilot in Command
PM	Pilot Monitoring
PNF	Pilot Not Flying
QAR	Quick Access Recorder
QNH	Query Nautical Height
RALT	Radio Altitude
RVR	Runway Visual Range
SARPs	Standard And Recommended Practices

SIGMET	Significant Meteorological Information
SMS	Safety Management System
SOP	Standard Operating Procedure
SPECI	Special Weather Report
SSCVR	Solid State Cockpit Voice Recorder
SSFDR	Solid State Flight Data Recorder
TAF	Terminal Area Forecast
UTC	Co-ordination Universal Time
VHF	Very High Frequency
VOR	VHF omni directional range
WAFCs	World Area Forecast Centre
WSO	Watch Supervisory Officer

FINAL INVESTIGATION REPORT
ON ACCIDENT
TO AIR INDIA AIRBUS A-320 AIRCRAFT VT-ESH
AT JAIPUR
ON 05.01.2014

- | | | |
|------------------------------|---|--------------------------------|
| 1. Aircraft Type | : | AIRBUS |
| Model | : | A-320 |
| Nationality | : | INDIAN |
| Registration | : | VT-ESH |
| 2. Owner | : | AIR INDIA LTD. |
| 3. Operator or Hirer | : | AIR INDIA LTD. |
| 4. Pilot in Command | : | ALTP holder |
| 5. Date of Occurrence | : | 05.01.2014 |
| 6. Time | : | 1540 UTC |
| 7. Last point of Departure | : | GUWAHATI |
| 8. Point of intended landing | : | DELHI |
| 9. Crew on board | : | 6 |
| Extent of Injuries | : | Nil |
| 10. Passengers on board | : | 173 |
| Extent of Injuries | : | Nil |
| 11. Type of operation | : | SCHEDULE OPERATION |
| 12. Phase of operation | : | LANDING |
| 13. Type of Occurrence | : | Aircraft landed in Soft Ground |
| 14. Place of Occurrence | : | Jaipur Airport |
| 15. Damage to aircraft | : | Substantial (Hull loss) |

(ALL THE TIMINGS IN THIS REPORT ARE IN UTC
UNLESS OTHERWISE MENTIONED)

1.0 FACTUAL INFORMATION

1.1 History of Flight

On 05.01.2014, Air India Ltd. Airbus A-320-231 aircraft was scheduled to operate flight AI-889 (Delhi – Guwahati – Imphal) and return flight, AI-890 (Imphal – Guwahati – Delhi). Air India dispatch section at Delhi, which has received the roster of flight crew for the flights, had prepared the operational and ATC flight plans by using FWz flight planning software and taking into account the weight & weather (forecast winds).

Same set of flight crew and cabin crew was rostered to operate the four sectors mentioned above. The flight was under Command of an ATPL holder with another ATPL holder as First Officer (FO) and 04 Cabin Crew members. The Commander was CAT III qualified and the FO was CAT I qualified.

The FWz plan was prepared for VT-ESL, but later on the aircraft was changed to VT-ESH. As per the pilot in command as both the aircraft have bogie gear type of landing gear and the performance factor is also same for these aircraft, he had accepted the FWz plan of VT-ESL.

As per the manager flight dispatch on duty, only first leg i.e. Delhi-Guwahati was dispatched. Required fuel figures were informed to the engineering & commercial departments. Pilots were briefed with folders which in addition to flight plans contained current NOTAMs and meteorological information. The relevant information in these documents was highlighted for briefing to the flight crew. For the remaining sectors which were self briefing sectors flight plan and NOTAMs were given to the flight crew.

As per the pre flight briefing register, both the crew members have visited the flight dispatch section for briefing and at around 10:40 hrs. IST have signed the dispatch register. The sectors Delhi – Guwahati – Imphal – Guwahati were as per schedule and were uneventful.

As per the flight sector report, the transit time at Guwahati prior to Guwahati-Delhi sector was 50 minutes. The aircraft landed at Guwahati from Imphal at 11:15 hrs. UTC and 12.7 tons of fuel was uplifted.

The filed alternates for the sector were Lucknow and Jaipur in that order. METARs of Delhi, Lucknow and Jaipur were provided at Guwahati. There was no specific briefing. Flight crew has taken the weather updates of destination and alternates before departure from Guwahati. Lucknow visibility at that time was 2000 meters with temperature and dew point of 18°C & 13°C respectively. The weather at Delhi (11:05 UTC) was RVR as 500 meters for runway 29, general visibility of 150 meters, with both temperature and dew point of 12°C. A speci was issued at 1130 UTC for Jaipur with winds 04 kts. visibility 3000m and haze. There was no significant clouding (NSC), temperature (T) 18°C & dew point (Dp) 13°C, QNH 1013.

Pre flight walk around inspection was carried out by the crew at Guwahati and the aircraft was released by an Aircraft Maintenance Engineer which was accepted by the Pilot-in-command. There was no snag or technical problem with the aircraft. There was no component or system released under Minimum Equipment List (MEL). For its last leg, the aircraft departed Guwahati for Delhi at 1205 UTC with 173 passengers on board.

The fuel requirement from Guwahati to Delhi with 179 persons on board was 12.2 tonnes. As per the commander of flight, additional 500 kgs of fuel was taken (total on board was 12.7 tonnes) considering the time of arrival in Delhi was that of traffic congestion and because of weather in Delhi. As per the Operational Flight Plan (OFP), there was 10 minutes of arrival delay at the destination.

The aircraft was flown on managed speeds. Initially the flight was cleared by ATC for a lower level and was later on cleared to fly at cruising level of 340. The fuel was checked visually on the Flight Management System (FMS) and Fuel Page which was further cross checked with the OFP planned figures by the crew on way points but was not recorded on the Operational Flight Plan. As per the crew, the fuel consumed was marginally higher than planned. The time taken to reach the way points was also noted, which was almost the same as planned figures were. Enroute, there was no briefing about traffic congestion over Delhi by any of the ground stations of AAI. The

crew, on reaching overhead Lucknow, has taken Lucknow weather and when the aircraft was in range of ATIS Delhi, Delhi ATIS weather was also copied.

The aircraft was not equipped with Aircraft Communications Addressing and Reporting System (ACARS) but was provided with HF/VHF system. As per the flight crew no flight following was provided either by flight dispatch or the IOCC of Air India. Weather updates were not sought by the crew from the flight dispatch nor were any updates provided by Flight dispatch to the aircraft during the flight except when crew had asked Delhi dispatch about Jaipur visibility before finally making the decision to divert to Jaipur.

Flight crew did not seek any update of Delhi or Jaipur weather till the time the aircraft came in contact with Delhi ATC. While in contact with Delhi ATC, the flight was advised to join hold as Delhi visibility Runway 28 RVR had dropped to the lower end of CAT I operations at this point runway 29 was below minima. AI 890 was number 12 in sequence and continued to remain in the holding pattern for the next 20-25 minutes. During this period there was no attempt on the part of flight crew to seek Lucknow weather. Air India Flight dispatch has also not given any advice to the flight about Jaipur or Lucknow weather.

The weather (visibility / RVR) reported on Runway 29 was below CAT I conditions so runway was not available for this flight at that moment as the First Officer was only Cat I qualified. As per commander of the flight, they did 03 holds each of 1.5 minutes leg and flew headings 360° and 180° before intercepting the localizer Runway 28 at 35 miles. RVR runway 28 also dropped below Cat. I minimas, therefore the crew discontinued approach and climbed to 8000 feet on runway heading before going on heading 180.

As per the Commander, though the 1st planned diversion alternate was Lucknow which had visibility of 2000 m i.e. above minima, but change of diversion to Jaipur was made as after missed approach they were closer to Jaipur and they had inquired about the visibility from Dispatch for Jaipur, which was provided as 2000 m. At this stage the crew did not check complete weather of Jaipur. Minimum diversion fuel to Jaipur was 2.9 tonnes as per

FWz CFP. AI-890 commenced diversion to Jaipur with “Fuel on Board” of 3.1 tonnes.

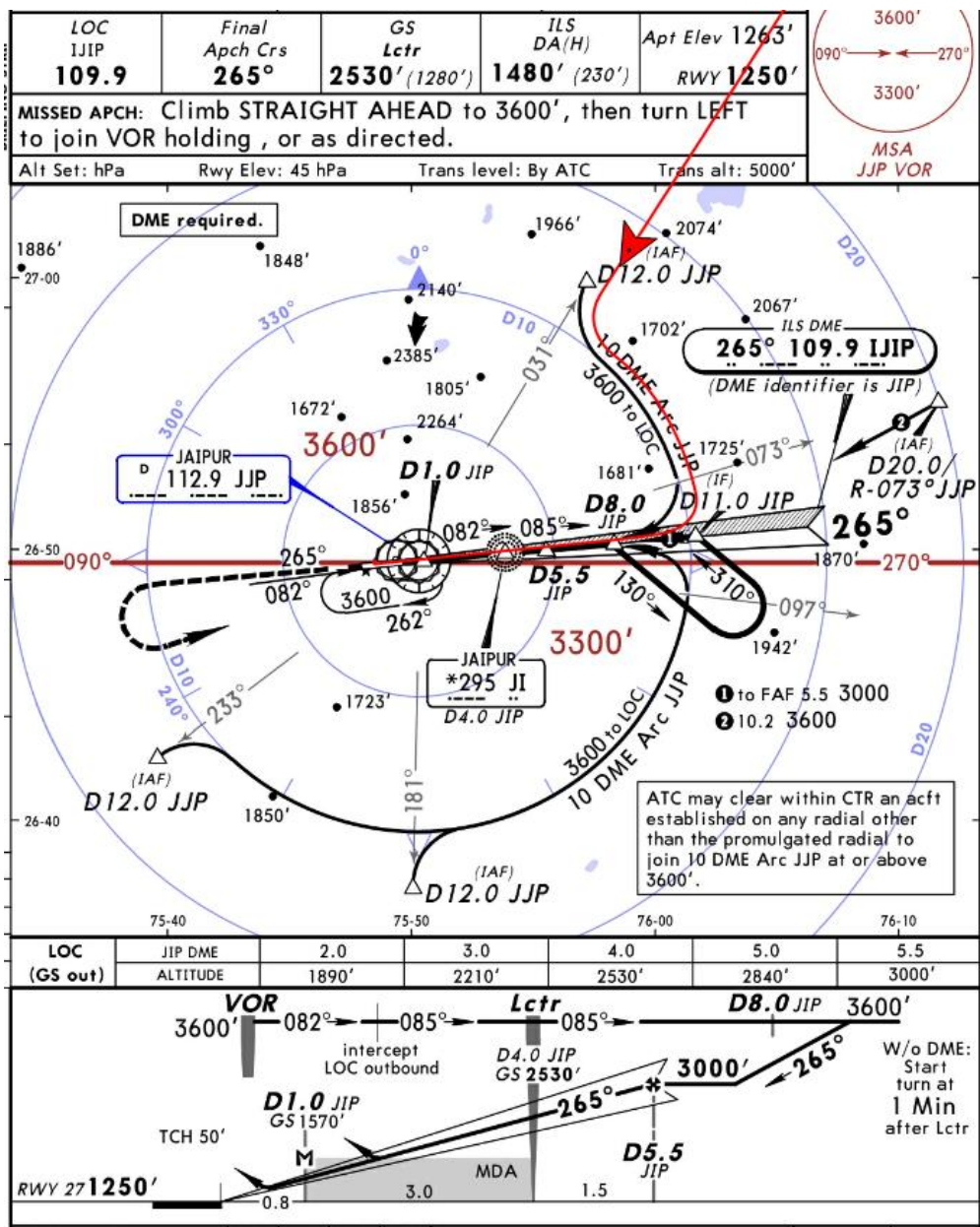
As per the Station Manager of Air India at Jaipur Airport, he received a call from their Executive Director, Northern Region at around 2040 hrs. IST on 05.01.2014 that due to Delhi weather, AI 890 had diverted to Jaipur. He then conveyed the same to the airport office and the concerned engineer.

The aircraft came in contact with Jaipur for the first time when it was at 68 DME from Jaipur. At that time the crew came to know of the complete weather of Jaipur from ATIS as visibility of 900 m, Dew Point as 13°C, temperature as 13°C, and RVR of 1000m. At 60 miles and passing flight level 138, the crew intimated Jaipur that the aircraft is descending for flight level 100 as cleared by Delhi control, which was acknowledged by Jaipur ATC. The aircraft again informed Jaipur ATC its position at 55 miles, 50 miles and 42 miles from Jaipur which were also acknowledged by Jaipur ATC. During these contacts, weather of Jaipur was neither asked by the crew nor provided by the ATC. When the aircraft was at flight level 83, the crew asked ATC Jaipur to confirm that they can carry out ILS approach for runway 27 via 10 DME arc. While confirming the requested approach, Jaipur ATC has informed all the stations about the weather at that moment as visibility 400 m and RVR 1000 m.

When the aircraft was at 30 miles from Jaipur, Jaipur ATC passed weather as visibility 400 m, RVR 1000 m and trend visibility becoming 350 m. The crew was asked to come overhead by Jaipur ATC. At 28 DME from Jaipur, the aircraft was maintaining 6000 feet and on request was cleared by Jaipur ATC to descend to 5000 feet.

When the aircraft was at 25 DME, from Jaipur, ATC advised that the weather was deteriorating rapidly and visibility was 400 meters. The crew however intimated the ATC that they were committed to land at Jaipur due fuel. As per the crew the fuel on board at that point of time was 2.6 tonnes (approx.) and approach was commenced for Jaipur with a visibility of 500 m with trend reducing.

The aircraft was no. 2 in approach at Jaipur and was cleared for VORDME arc ILS approach runway 27 at 25 nm. Crew had, as per them, checked Ahmedabad distance as 291 nm, with a fuel calculation of 2.7 tonnes and as sufficient fuel was not available for Ahmedabad so did not consider diverting to Ahmedabad at that moment. Crew has also stated that Udaipur watch hours were not available with them, Jodhpur is an Air Force field with restrictions and Delhi was packed so they continued approach to Jaipur knowing that visibility / RVR was rapidly deteriorating.



Due to reducing visibility, Jaipur ATC asked all the aircraft inbound for Jaipur to come over head and join JJP hold. The crew of the subject flight asked for the weather which was provided as visibility 400 m & RVR 1000 m though RVR deteriorating to 550 m.

The flight from the “Arrival Route” flew the VORDME arc for ILS runway 27. The ATC had transmitted the RVR as 200 m and visibility as 50 m with trend reducing. Another scheduled flight ahead of AI-890 carried out a missed approach and diverted to Ahmedabad. When the aircraft was above MDA (1480 feet AGL), ATC reported RVR 50 m and cleared the aircraft to land subject to minima. Both the flight crew maintained that they had seen the runway lights. ILS approach was performed with dual AP until 200ft RALT. After descending below MDA on auto pilot, the commander disconnected the auto pilot. Captain performed the final approach manually. The aircraft deviated to the left of the runway centre line and touched down on soft ground (in kutchra) on the LH side of the runway. During touchdown and landing roll, the visibility was zero and crew were unable to see any of the reference cues. The crew had heard rumbling sound during landing roll.

As per the commander, he did the manual landing as he was not sure if he could do auto-land on a ground facility which is CAT I certified airfield in actual zero visibility.





Left main wheel rolled over the drain boundary area

The aircraft continued to roll/ skid on the unpaved surface and during this period the left wing impacted trees causing damage to the left wing. Thereafter aircraft turned right and entered the runway finally coming to a halt on the LH side of runway. There was no fire.



ATC Jaipur informed the Airport Manager of the Airline at Jaipur that their flight AI-890 had blocked the runway and also requested them to send equipments / manpower to attend the aircraft and get the aircraft removed. The Station AME of the airline alongwith the Asst Officer (Comm.), who was at the tarmac were instructed by the Station Manager to move to the aircraft. As per the AME, the visibility was almost nil and they could not move without the help of 'Follow Me' Jeep. The ATC was informed to arrange the jeep to escort the personnel upto the aircraft. The AME after reaching the aircraft observed that the no. 1 main wheel of the aircraft had decapped/ damaged and the port side wing was damaged. The fuel remaining on board was 2400 kgs.

The disembarkation of passengers was carried out on the runway itself and passengers were sent to the terminal building. Since the aircraft was not in a position to be either taxied or towed to the parking bay, the baggage of passengers was offloaded at the runway itself and sent to the terminal.

One passenger suffered minor bruise on the knuckle of his right hand middle finger. He was attended to by the cabin crew in the aircraft and also by the doctor at the airport. Medical check-up of all the crew members including breathanalyser (BA) test was done by the medical officer, M.I. room Jaipur

airport. The BA test was negative for all the crew members with a reading of 00.00.

Since the aircraft was obstructing the runway, the airport was shut down for any further flight operations till the runway could be cleared. A NOTAM was issued to this effect. The aircraft was towed the next day to parking bay no.5 at terminal-1 by 1200 hrs and was later repositioned on a non-operational remote bay.

1.2 Injuries to Persons

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
NONE	6	173	

1.3 Damage to Aircraft





The aircraft had touched on the left side of the runway on soft ground. There was no damage to the aircraft on its first impact with the soft ground. The aircraft had rolled and then the left wheel had gone over the drain boundary area. The left main wheels got de-capped / damaged during this roll over/ skidding and during final stoppage with application of brakes.

Thereafter the aircraft turned right but at the same time hit trees wherein the left wing leading edge structure got damaged from rib 23 onwards. Outboard wing spar box including upper skin, lower skin, front spar, rear spar and ribs got sheared off from a distance of about 5 ft from the wing tip.



- Wing tip and wing tip fence area sheared off and found in drain.



- Slat #3 and #4 found damaged.
- Slat #5 broken and found near drain.



- Wing leading edge structure was found damaged from rib 23 onwards.
- Slat wing tip brake and hydraulic lines damaged at front spar.
- Rear spar sheared from rib 25.
- Upper flange of rear spar cracked outboard from rib #24.
- 1/3rd portion of aileron outboard area sheared off.
- Left outboard flap damaged near outboard tip lower surface.
- Aileron upper and lower access panels damaged.
- Wire bundle on front spar pulled/damaged/snapped outboard of rib #23.
- No. 1 main wheel found decapped.
- Observed multiple cuts and rubs on main wheel #5.
- Grass straws observed on fan blades of both the engines.
- Blue system loss due hydraulic line ruptured in slat 5 area.



1.4 Other damage

There was no damage to either runway or lights etc. Branches of trees on the side of the runway were cut by the left wing.



1.5 Personnel information

1.5.1 Pilot-in-Command

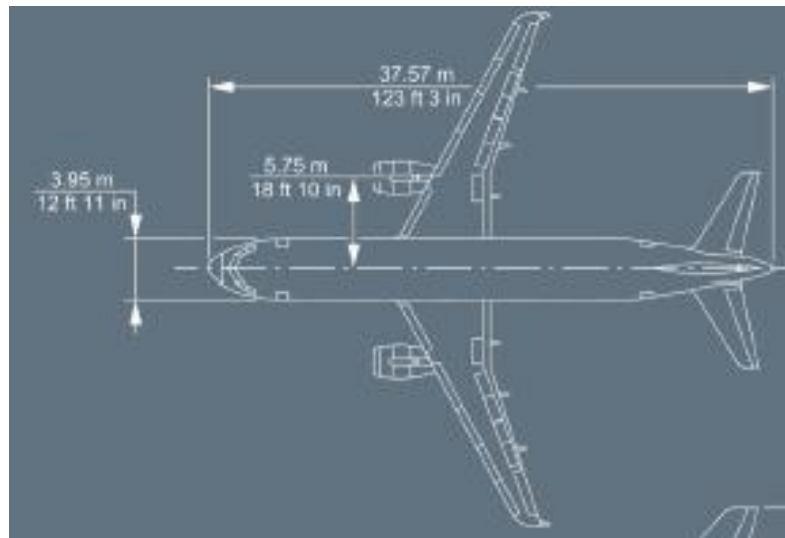
Pilot-in-Command	Line Pilot, Male
Age	43 Yrs
Licence	ATPL
Date of Issue	11.07.2013
Validity	valid
Type endorsements/Aircraft rating	A-320, B-200, C-152
FRTTO - Date of Issue	13.05.1993
Valid upto	02.07.2018
Medical Certificate	Valid
Date of Medical Exam	02.12.2013
Medical Exam Valid upto	01.06.2014
Date of last IR/PPC Simulator Check	11.09.2013
Total flying Experience	8322:00 hours
Total Experience on Type	5502:00 hours
Experience as PIC on Type	3039:00 hours
Hours flown in last 180 days	528:40 hours
Hours flown in last 90 days	235:10 hours
Hours flown in last 30 days	78:00 hours
Hours flown in last 7 days	20:35 hours
Hours flown in the last 24 hrs	07:35 hours

1.5.2 Co-pilot

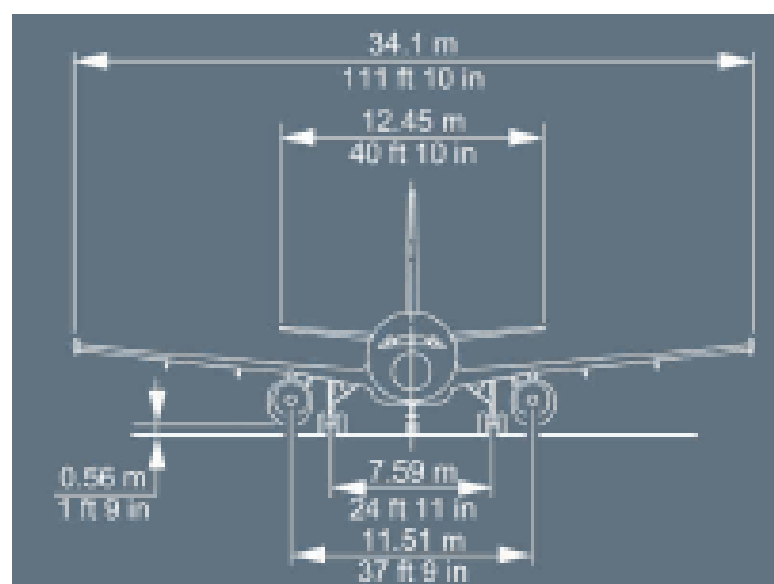
Co-pilot	Line Pilot, Male
Age	46 Years
Licence	ATPL
Date of Issue	10.01.2013
Valid upto	09.01.2015
Type endorsements/Aircraft rating	A-320
FRTO	Valid
Date of Issue	18.02.2005
Valid upto	17.02.2015
Medical Certificate	Valid
Date of last IR/PPC Simulator Check	25.07.2013
Total flying Experience	2798:58 hours
Total Experience on Type	2610:00 hours
Experience as PIC on Type	Nil
Hours flown in last 180 days	464:22 hours
Hours flown in last 90 days	216:39 hours
Hours flown in last 30 days	88:39 hours
Hours flown in last 7 days	20:35 hours
Hours flown in the last 24 hrs	07:35 hours

1.6 Aircraft information:

Airbus A-320 is a narrow body, single aisle, subsonic jet transport aircraft. The fuselage is pressurised throughout except nose cone, tail cone, landing gear bays and air-conditioning compartment. All aircraft and system controls for the conduct of the flight are arranged in such a manner that both the crew members can monitor instruments and systems.



Though it may vary, the aircraft can carry 168 passengers in 28 rows, each row having 6 seats. The seats are 3 on either side with a central aisle. The flight deck of the aircraft is designated for two pilot operations.



The aircraft uses Fly by Wire flight controls operated by sidestick controls. It has six large cathode ray tube (CRT) display known as Electronic Instrument System which is divided into two parts name EFIS (Electronic Flight Instrument System) and ECAM (Electronic Centralised Aircraft Monitor). The EFIS has two CRT's each in front of the pilots and displays mainly flight parameters and navigation data on the PFD (Primary Flight Display) and the ND (Navigation Display). The ECAM utilises two CRT's one below the other on the centre instrument panel known as Engine/Warning display and system display. The displays on these are engine primary indications, fuel quantity indications, flaps and slats position indications, warning and caution alerts, memo messages, aircraft system synoptic diagrams, status messages, flight data etc.

The flight management and guidance systems (FMGS) is a pilot interactive system which provides autopilot control, flight director commands, auto thrust control, rudder commands, flight envelope computations, navigation, nav radio auto tuning, performance optimisation and information display management. The aircraft is provided with Full authority Digital electronic Engine Control (FADEC) which provides a full range of engine control and receives its commands from FMGS.

The aircraft details are as follows:

AIRFRAME	
Manufacturer	AIRBUS
Type	A-320-231
Constructors S. No.	469
Year of Manufacturer	1994
Certificate of Airworthiness	2086
Date of Initial Issue	18.05.1994
valid up to	24.01.2014
Category	Normal
Sub Division	Passenger/Mail/Goods
Certificate of Registration	2598/3
Minimum Crew Required	2
Maximum All Up Weight	73,500 Kg

Last Major Inspection	'3A' Check
Carried out at	55305:56 Flight Hours
on	24.11.2013
Air Frame Hours since New	55705:35
Air Frame Hours since last C of A	5351:33

The aircraft is fitted with two International Aero Engine IAE V-2500 high bypass ratio (5.44:1) turbo fan engines rated at 25,000 lbs. take off thrust at sea level and flat rated to ISA + 15°C. The aircraft is equipped with a FADEC (Full Authority Digital Electronic Engine Control) system which provides gas generator control, engine limit protection, power management, automatic engine starting, flight deck indication data, thrust reverser control and feedback and acts as a propulsion data multiplexer making engine data available for condition monitoring.

Engine thrust control is provided by FADEC. Thrust selection is achieved by means of the thrust lever in manual mode or the FMGS in auto thrust mode to maintain a given speed or required thrust setting. The engine details are given below:

ENGINE	LEFT (NO.1)	RIGHT (NO.2)
Manufacturer	IAE	IAE
Type	V2500-A1	V2500A1
Serial No.	V0087	V0109
Hours done since New	47501.55	48258.19
Time since last Shop Visit	4424	1877
Last Inspection carried out	Pre-flight	Pre-flight
Last Major Inspection	'3A' Check	'3A' Check

The aircraft station licence issued by Ministry of Communication, was valid. The Noise Certificate was issued on 18.09.2006. The Empty Weight of the aircraft was 39844.37 kgs and the aircraft was weighed on 24.05.2013. The Centre of the Gravity (CG) of the aircraft was within limit.

1.7 Meteorological information

The relevant METAR information for the destination (Delhi) & the two alternates i.e. Jaipur & Lucknow are as follows:

TIME	RELEVANT METARS FOR DELHI (5 th Jan. 2014)
0000Z	0503/0512 0000KT 0100 FG VV/// BECMG 0504/0505 0500 MIFG BECMG 0506/0508 1500 FU/BR NSC TAF
0500Z	0000Kt 0100 R28/0700 R29/0450 Fg VV/// 13/11 Q1017 BECMG 0150≡
0900Z	0512/0521 27005KT 0400 FG NSC BECMG <u>0515/0516 VRB02KT</u> <u>0200 FG VV/// BECMG 0518/0519 0050 FG TAF</u>
1130Z	27005KT 0250 R28/0850 R29/0500 FG NSC 15/15 Q1012NOSIG=
1200Z	25004KT 0250 R28/0750 R29/0500 FG NSC 14/14 Q1012NOSIG=
1230Z	26004KT 0200 R28/1000 R29/0700 FG VV/// 13/13 Q1013 NOSIG=
1300Z	27003KT 0150 R28/0900 R29/0600 FG VV/// 13/13 Q1013 NOSIG=
1330Z	26003KT 0150 R28/1150 R29/0500 FG VV/// 12/12 Q1013 NOSIG=
1400Z	VRB02KT 0100 R28/0850 R29/0375 FG VV/// 12/12 Q1013 NOSIG=
1430Z	00000KT 0050 R28/0800 R29/0200 FG VV/// 11/11Q1013 NOSIG=
1530Z	00000KT 0000 R28/0450 R10/0050 R29/0000 R11/0050FG VV/// 09/09 Q1014 NOSIG=
1600Z	00000KT R28/0450 R29/0000 R10/0040 R11/0000 FG VV/// 08/08 Q1014 NOSIG=
1630Z	00000KT R28/0400 R28M/0800 R29/0000 R10/0040R11/0000 FG VV/// 08/08 Q1014 NOSIG=
1700Z	26003KT 0000 R28/0050 R28M/0050 R10/0050 R29/0000 R11/0000 FG VV/// 08/08 Q1014 NOSIG=
1730Z	23003KT 0000 R28/0050 R28M/0050 R10/0050 R29/0000 R11/0000 FG VV/// 08/08 Q1014 NOSIG=

TIME	RELEVANT TAFs FOR JAIPUR (UTC) (4 th Jan. 2014)
1800	0421/0506 VRB02KT 1200 BR FEW035 BECMG 0423/0501 00000KT 0800 MIFG BECMG 0504/0505 09005KT 1500 BR=TAF
2100	VIJP 042100Z 0500/0509 00000KT 0800 MIFG NSC BECMG 0504/0505 02005KT 1500 BR BECMG 0506/0508 3000 HZ=TAF

TIME	RELEVANT METARS FOR JAIPUR (UTC) (5 th Jan. 2014)
0000	00000KT 0800 MIFG SCT035 BECMG 0504/0505 09004KT 1500 BR BECMG 0507/0509 3000 HZ= TAF
0020	00000KT 0050 R27/0450V2000D FG 13/13 Q1014 NOSIG= SPECI
0032	00000KT 0050 R27/0250D FG 13/13 Q1014 NOSIG= SPECI
0430	26004KT 0100 R27/0175N FG VV/// 12/12 Q1018 BECMG0350= SPECI
0430	26004KT 0100 R27/0175N FG VV/// 12/12 Q1018 BECMG 0350= SPECI
0500	0000KT 0150 R27/0275N FG VV/// 13/13 Q1018 BECMG0350 m ≡
0500	0503/0512 00000KT 0800 MIFG SCT035 BECMG 0504/0505 09004KT 1500 BR BECMG 0507/0509 3000 HZ= TAF
0530	VRB02KT 0350 R27/0500N FG VV/// 13/13 Q1017 BECMG 0600= SPECI
0551	VRB03KT 0600 R27/0800N MIFG VV/// 13/13 Q1017 BECMG 0800= SPECI
0551	VRB03KT 0600 R27/0800N MIFG VV/// 13/13 Q1017BECMG 0800= SPECI
0630	VRB01KT 0900 R27/1100N MIFG VV/// 14/14 Q1016BECMG 1500= SPECI
0630	VRB01KT 0900 R27/1100N MIFG VV/// 14/14 Q1016 BECMG 1500= SPECI

0730	27004KT 1600 R27/1900U BR SCT035 BKN100 16/14Q1015 NOSIG= SPECI
0900	VRB02KT 2000 BR FEW035= TAF
1130	20004KT 3000 HZ NSC 18/13 Q1013 NOSIG= SPECI
1230	18004KT 2000 FU NSC 16/14 Q1013 NOSIG=
1330	VRB01KT 1500 R27/P2000N BR NSC 14/14 Q1014 NOSIG=
1330	VRB01KT 1500 R27/P2000N BR NSC 14/14 Q1014 NOSIG= SPECI
1430	VRB00KT 0900 R27/1500D MIFG NSC 13/13 Q1014 BECMG 0800=
1500	VRB01KT 0900 R27/1300D MIFG NSC 13/13 Q1014 BECMG 0800=
1517	VRB03KT 0400 R27/1000D FG VV/// 13/13 Q1014 BECMG0350= SPECI
1526	00000KT 0050 R27/0200V1100D FG VV/// 13/13 Q1015NOSIG= SPECI
1630	00000KT 0000 R27/0150 FG NSC 13/13 Q1015 NOSIG=
1730	00000KT 0000 R27/0125 FG NSC 12/12 Q1015 NOSIG=
1800	0521/0606 VRB02KT 0050 FG NSC BECMG 0604/0605 0800 MIFG= TAF

Jaipur, as an airfield, does not report weather trends. However, post accident, when the Committee of Inquiry visited Jaipur Met Office, it was given to understand that trends are being issued post 05th January, 2014.

TIME	RELEVANT METARS FOR LUCKNOW (UTC) (5 th Jan. 2014)
0000	VRB02KT 0400 FG FEW020 SCT100 BECMG 0504/0506 29006KT 1200 BR/HZ BECMG 0507/0509 3000 HZ= TAF
0030	28006KT 0600 R27/1200 FG VV/// 13/12 Q1014 BECMG 0800

	MIFG= SPECI
0430	VRB01KT 0800 R27/0900 MIFG FEW100 15/13 Q1016 NOSIG= SPECI
0500	VRB02KT 1000 R27/1200 MIFG FEW020 SCT 100 16/12 Q1016 BECMG 1500=
0530	VRB02KT 1800 R27/P2000 BR FEW020 SCT10017/13 Q1015 NOSIG= SPECI
0730	32003KT 3500 HZ FEW100 21/11 Q1013 NOSIG= SPECI
0900	VRB02KT 2000 HZ/FU FEW100 BECMG 0516/0518 1000 BR BECMG 0519/0521 0800 BR/MIFG= TAF
1130	29005KT 3000 HZ NSC 20/14 Q1011 NOSIG= SPECI
1200	27004KT 2500 HZ NSC 20/13 Q1011 NOSIG=
1230	26003KT 2500 HZ NSC 19/13 Q1011 NOSIG=
1300	27004KT 2000 HZ NSC 18/13 Q1012=
1330	26003KT 2000 HZ NSC 17/13 Q1012 NOSIG=
1400	25003KT 2000 HZ NSC 17/14 Q1012 NOSIG=
1430	26004KT 2000 HZ NSC 16/14 Q1013 BECMG 1500=
1500	29003KT 2000 BR NSC 16/13 Q1012 NOSIG=
1530	27003KT 2000 BR NSC 15/13 Q1013 NOSIG=
1630	27003KT 1500 R27/P2000 BR NSC 15/13 Q1013= SPECI

1715	VRB02KT 0500 R27/1400 FG NSC 14/13 Q1013= SPECI
1730	VRB02KT 0500 R27/1400 FG NSC 14/12 Q1013=

The meteorological department, for Delhi airport has a system of providing the weather information through the website (www.imd.gov.in) and through on line briefing system of Airport Meteorological Office, which provide information on weather forecast for six hours, current weather and visibility of IGI airport and weather information of alternate airport(s).

DGCA has issued guidelines for aircraft operations during low visibility conditions at IGI airport Delhi vide Aeronautical Information Circular(s) from time to time (latest was 11 of 2009). As per these guidelines, IMD is required to provide MET forecast at 0600, 1200 and 1800 UTC for fog on their website along with instantaneous RVR for runway 27, 11/29. RVR for runway 28 is provided on continuous basis with 30 minutes update on the website. The 1200 UTC forecast is most essential for the flight planning purposes for the next day which is utilized by the Airlines for flight planning purposes.

The guidelines require that ATC Delhi shall inform to outstations metro airports (BOM, CCU, HYD etc.) about the “estimated time of touchdown”, depending on the traffic situation, on an hourly basis applicable for two hours \pm 10 minutes to facilitate the airlines to plan their departure from above stations to Delhi.

The guidelines also require that with the deteriorating trend of visibility detected at IGI airport, Duty Officer MET, IGI airport, shall inform the WSO as the RVR becomes less than 1200 meters and also when the visibility forecasted indicates deterioration of visibility to 800 meters or less. This information shall also be passed by MET at IGI airport to the Airlines and other agencies whenever enquiries about visibility conditions are received from Airlines to plan their flight scheduling. The Airlines are required to plan their departures and arrival at IGI airport on the basis of the above information. Further all airlines are required to monitor this trend through telephone or the ATIS broadcast for their planning of flight departures and

passenger facilitation. WSO on receipt of visibility reports, and at the appropriate time is required to ensure broadcasting on ATIS, whenever CAT II and CAT III-A/B conditions are in vogue.

Further guidelines emphasise that Airlines shall ensure that only those pilots who are adequately trained and certificated for Low Take-off Minima are rostered for operating flights during low visibility conditions from/to Delhi to ensure aircraft operation during low visibility conditions especially during CAT II and CAT III-A/B conditions. All airlines shall plan the flight as per the schedule separately filed for the fog period.

1.8 Aids to Navigation

Jaipur airport is an international airport owned by Airports Authority of India. Both VFR and IFR traffics are permitted.

The approach and runway lighting on runway 09/27 are as follows:

Designations RWY	APCH LGT TYPE LEN INTST	THR LGT COLOUR WBAR	VASIS (MEHT) PAPI	TDZ, LGT LEN	RWY centre line LGT Length, spacing, colour and intensity	RWY edge LGT Length, spacing, colour and intensity
1	2	3	4	5	6	7
09	SALS 420M	Green	PAPI Left/3° 15.244M	---	---	2797M 60M White, HIL
27	CAT I 900M	Green	PAPI Left/3° 15.73M	---	---	2797m 60M White, HIL

The ATS communication facilities with frequencies and hours of operation are as follows:

Service designation	Call sign	Frequency	Hours of operation	Remarks
1	2	3	4	5
APP	Jaipur Approach	125.25 MHZ	H24	
TWR	Jaipur Tower	125.25 MHZ	H24	Standby Freq for TWR 124.3 MHz
ATIS	Jaipur Information	126.6 MHZ	As ATS	

Various Radio, Navigation and Landing aids provided on the runway 27 are as follows:

Type of aid CAT of ILS/MLS (For VOR/ILS/MLS, give VAR)	ID	Frequency	Hours of operation	Site of transmitting antenna	ELEV of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
LLZ 27	IJP	109.9 MHz	H24	264921.7 N 0754745.2 E	---	
GP 27	-	333.8 MHz	H24	264934.9 N 0754923.3 E	---	
LO	JI	295.0 kHz	H24	264952.8 N 0755351.0 E	350 M /1148 FT	
DME (HP)	JJP	1100/1163 MHz	H24	264933.24N 0755018.20E	1263FT	Collocated with VOR
DME(ILS)27	JJP	997/1060 MHz	H24	264934.9N 0754923.3E	1249M	Collocated with GP
DVOR	JJP	112.9 MHz	H24	264933.24N 0755018.20E	---	

There were no known navigational aid difficulties reported by the crew. The approach and runway lights were reported to be serviceable on the day of the accident. As per the communication debriefing/ calibration reports all the facilities (Nav aids) were performing satisfactorily.

1.9 Communications

There was two-way communication between the aircraft and ATC. Neither the flight crew nor the ATC officers have encountered any difficulty in communication.

1.10 Aerodrome information

Jaipur airport is owned and fully controlled by Airports Authority of India. The co-ordinates of the aerodrome reference point are 26°49'27" N & 07°54'81"E. The elevation of the ARP is 1263 feet. The airfield has a single runway 09/27 which is 2797 meters long and 45 meters wide. The magnetic bearing of the runway are 085°/265° which are same as geographical bearings. The elevation of runway 09 threshold is 1263 feet and that of runway 09 is 1250 feet. The declared distances of TORA, TODA, ASDA and LDA for both runway 09 and 27 are 2797 meters. There are no obstructions in the approach and take off areas. The runway is marked with runway

threshold, touchdown, centerline and runway side line markings. The physical characteristics of the runways are given below:

Designations RWY NR	TRUE & MAG BRG	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY (FT)
1	2	3	4	5	6
09	85.00° GEO 85.00° MAG	2797 x 45	84/F/B/W/T Upto 1806M from beginning Rwy 09 and rest.61/R/B/ W/T. Tarmac Concrete	264922.50N 0754753.60E	THR:1263.0FT TDZ:1263.1FT
27	265.00° GEO 265.00° MAG	2797 x 45	61/R/B/W/T Up to 991M from beginning Rwy 27 and rest 84/F/B/W/T Tarmac Concrete	264931.00N 0754938.00E	THR:1250.0FT
Slope of RWY-SWY	SWY dimensions (M)	CWY dimensions (M)	Strip dimensions (M)	OFZ	Remarks
7	8	9	10	11	12
---	---	---	2917 x 150	---	---
---	---	---	2917 x 150	---	---

Jaipur airport meets the ICAO category VII requirements in respect of fire and rescue services. As per the AIP India, the details of the meteorological information provided at Jaipur are as follows:

1	Associated MET Office	Jaipur
2	Hours of service MET Office outside hours	H24 ---
3	Office responsible for TAF preparation period of validity	Jaipur/Delhi 9,24 HR
4	Trend forecast interval of issuance	NIL
5	Briefing/consultation provided	Provided
6	Flight documentation Language(s) used	Tabular Form English
7	Charts and other information available for briefing and consultation	Avbl during VIP movt only
8	Supplementary equipment available for providing information	Telex/Telefax
9	ATS units provided with information	Jaipur ATC and ACS.
10	Additional information (limitation of service, etc.)	NIL

1.11 Flight Recorders:

i) Quick Access recorder:

The aircraft was installed with Quick Access Recorder (QAR) as an airborne flight data recorder for quick and easy access of raw flight data. The QAR like the aircraft's SSFDR also receives its inputs from the Flight Data Acquisition Unit (FDAU) for recording flight parameters though it is not designed to survive an accident. In the present accident however there was no damage caused to the QAR tape. The QAR tape was removed from the aircraft after the accident but was not working as the spool was found to be damaged. However no defect was either reported in the "Post Flight Report" (PFR) nor was any entry made in the aircraft "Technical Log".

ii) Solid State Cockpit Voice Recorder (SSCVR)

The aircraft was equipped with SSCVR bearing Serial Number 01398 and Part Number 2100-1020-02 manufactured by M/s L-3 Communications, USA. The CVR was found intact with Underwater Locator Beacon attached. There was no damage and the unit appeared in serviceable condition. All the 57 pins of rear connector were also found in perfect condition.

The unit was brought in the CVR/FDR laboratory of Aeronautical Engineering Directorate of Directorate General of Civil Aviation at Delhi. For downloading the digital audio files, Hand Held Downloading Unit (HHDLU) S. No. 000224918 (PNR -17TES0043) of L-3 communications was used after insertion of PCMCIA card. The HHDLU was connected to the front connector of the recorder. Raw data file of CVR was downloaded in the PCMCIA card. With the help of CVR utility software, raw file was converted into four (04) audio files, representing audio data contained in four different channels present in the CVR.

iii) Solid State Flight Data Recorder (SSFDR)

The aircraft was equipped with SSFDR bearing Serial Number 000180246 & Part Number 2100-4043-02 manufactured by L-3 Communications, USA. The CVR was found intact without any damage as

seen from outside and appeared to be in serviceable condition. Plastic cover of rear connector (57 pins) was removed. All pins found in normal position.

The unit was brought in the CVR/FDR laboratory of Aeronautical Engineering Directorate of Directorate General of Civil Aviation at Delhi. For downloading the digital files, Hand Held Downloading Unit (HHDLU) was used after insertion of PCMCIA card. Raw data file of SSFDR was downloaded in the PCMCIA card. With the help of software NALFOQA of National Aerospace Lab., Bangalore, India, this raw data file was converted into engineering data files.

The raw data files downloaded were also forwarded to BEA France along with other associated evidences for their analysis and views on the circumstances leading to the accident. A detailed analytical report based mainly on the DFDR data was received from BEA France and has been utilized and discussed in the analysis portion of the report.

1.12 Wreckage and impact information

During final approach and landing, the aircraft deviated to the left of the runway centerline and touched down on soft ground LHS of the runway. After rolling for about 7 seconds in kutchra, the LH wing collided with a tree. Thereafter the aircraft came back and stopped on the runway.

The wreckage was totally self contained barring portion of LH wing (in parts) which was found between the drain and the runway edge, as discussed in the damage to aircraft.

1.13 Medical and pathological Information

Medical check-up including check up for consumption of alcohol (alco sensor check) of all the crew members was carried out by the doctor manning the M I Room at Jaipur airport. No samples of blood, urine etc. was taken for the flight crew.

DGCA has issued Air Safety Circular No. 6 of 2010 regarding “action required of police authorities in case of aircraft accidents & Serious Incidents.” AAIB has also issued Circular No O1 OF 2012 on the same subject. Though

the action required by civil authorities may vary from occurrence to occurrence but broad outlines of procedures/ actions required are enumerated there. For medical checkup following are the requirements:

“The Police authorities shall ensure that the Captain and the Copilot are immediately subjected to medical checkup for consumption of alcohol. The doctor carrying out such a medical checkup shall take samples of blood, urine etc. required for detailed chemical analysis. In the event of an accident at an AAI Airport/Greenfield airport/Privately Managed Airport or any other airports, samples of blood, urine etc. should be taken at the AAI medical centre, wherever available. In other cases where medical centers are not available at the airports or when the condition of crew members requires immediate hospitalization, the Police authorities shall ensure that the samples of blood, urine etc. shall be taken at the nearest hospital. These checks should be expeditiously carried out without any loss of time.”

1.14 Fire

There was no fire during the occurrence of accident or after the aircraft came to final halt on the runway.

1.15 Survival aspects

The accident was survivable. All the passengers and crew members deplaned of their own on the runway using step ladders.

1.16 Tests and research

NIL

1.17 Organizational and Management information

1.17.1 AIR INDIA

The airline is a scheduled operator and is an approved Maintenance Organisation under CAR 145 by DGCA. Relevant management, operational and procedural aspects of the operator are given in the following paragraphs:

(A) OPERATIONAL FLIGHT PLAN (OFP)

Details of 'Operational Flight Plan' (OFP) are available in Operations Manual part A, Chapter 16 Issue-3, Rev 0 dated 1st July 2013. For narrow-body (A-320 family), two types of OFP are available.

- a) Seasonal wind flight plans (With Fuel-tolerance of 10%)
- b) Forecast wind flight plan (also known as Computerised Flight Plan(CFP) with 5% fuel-tolerance)

The CFP is prepared by using software from a company called Fwz Flight Planning System. The system has a facility to prepare flight plans specifically for each tail number (i.e. OFPs can be issued specific to each aircraft). In this particular case, it was observed that the CFP issued for the accident aircraft (VT-ESH) actually was generated for VT-ESL.

Para 16.2 of the Operations Manual under operational flight plan is reproduced below:

16.2 OPERATIONAL FLIGHT PLAN (FUEL FLIGHT PLAN) PREPARATION AND RESPONSIBILITY

An operational flight plan shall be prepared for each flight. It is the responsibility of the Flight Operations officer/ Flight Dispatcher to prepare the flight plan. Copy of the flight plan shall be handed over to PIC either by the flight dispatcher or by qualified handling agent after completion of the flight plan preparation. The flight plans shall be approved and signed by (both) the Pilot-in-Command and Flight Operations officer /Flight Dispatcher. This copy is available with the crew for reference throughout the flight. Where a Flight Dispatcher or qualified handling agent for preparing Air India flight plan is not available, remote dispatch procedures are followed. In case of remote dispatch the flight plan shall have the name of the flight dispatcher and same to be signed by the PIC. As per Air India Policy the Operation Flight Plan is to be accepted after verification and signed by the PIC and Flight Operations officer /Flight Dispatcher during the flight preparation process and a copy is retained for a period of six months at all Stations on the network from where the flight is dispatched.

Separate copies of OFP must be provided for PF, PM/PNF and Supernumerary / Observation Crew.”

Para 16.3 of the above stated manual gives the explanation of the Sabre Flight Plan Manager. The data which is system generated (in the message body) is explained through the following example:

AIC131/20SEP10
 BOM/VABB/MUMBAI CHHATRAPATI SHIVAJI - LHR/EGLL/LONDON HEATHROW
 VABB 2050Z/2050L - EGLL 0630Z/0630L

DESTINATION ALTERNATE: CDG/LFPG/PARIS/CH. DE GAULLE

OFF ENTRY	EXPLANATION
DISPATCH RELEASE/FLIGHT RELEASE	Heading of the document
DISPATCH COPY	Indicates that this sheet will be retained at the Dispatch (the copy carried on board the flight will have "FLIGHT COPY" printed here)
AI131/20SEP10	Flight number and date of flight: <ul style="list-style-type: none"> • Scheduled block date of departure (UTC) and commercial call sign is given on top in heading (between decorative lines in bold font. • Estimated block date of departure (UTC) and ATC call sign is given on the first line of text.
VTALS	Aircraft registration.
BOM/LHR	City pair (IATA airports IDs)
BOM/VABB/MUMB AI CHHATRAPATI SHIVAJI INTL	Departure airport IATA, ICAO IDs followed by city and airport name
LHR/EGLL/LONDO N HEATHROW	Destination airport IATA, ICAO IDs followed by city and airport name
VABB 2050Z/2050L - EGLL 0630Z/0730L	Departure airport ICAO ID - Scheduled Departure Time in UTC/LT - Destination airport ICAO ID - Scheduled Arrival Time in UTC/LT (Presently the IST time is being printed wrongly - the problem is under rectification)
DESTINATION ALTERNATE CDG/LFPG/PARIS/ CH. DE GAULLE	Destination alternate (airport used for calculation of ALTN fuel, where two alternates have been allocated) IATA, ICAO IDs followed by city and airport name

(B) Flight Dispatch – General

Flight Dispatch sections of the airline (Narrow body) are located at major metro stations like New Delhi, Mumbai, Kolkata, Chennai, Bengaluru and Hyderabad. The flight was dispatched from New Delhi IGI Airport (T3).

During the process of investigation the documents made available to the Committee were Flight Dispatch register & RT communication log. The Committee discussed with the dispatchers of the three shifts who were on duty at Delhi Flight Dispatch from the time aircraft took off from Delhi till safe disembarkation of passengers at Jaipur covering various issues of flight dispatch, their training, Fwz plans etc. and the observations are discussed in the analysis portion. The Flight Dispatchers on duty when the accident flight was released maintained that the Guwahati-Imphal-Guwahati-Delhi sectors were self-dispatch sectors. No directions, guidelines or requirements came to the knowledge of the Committee for self dispatch.

Air India narrow body historically was using the “Seasonal Wind” Flight plans. Various personnel involved in flight dispatch informed that they have not undergone any specific training for preparing the Sabre Flight Plans (FWz CFP). Committee was not provided with any documents wherein any change management process was carried out prior to implementing the change. Most flight dispatchers were not conversant with the preparation of the CFP (though it is system generated) and how to detect gross errors.

The CFP were being generated for a specific weight, (in most cases with Max Zero Fuel Weight) however in case of any deviation from the Max Zero Fuel Weight, the CFP was not being re-issued. In net effect the aircraft may be burning more fuel as the aircraft would be flying at lower levels than what it could actually fly.

(C) INTEGRATED OPERATIONS CONTROL CENTER (IOCC)

As per para 1.21 of the above stated manual, the primary objective of the Integrated Operational Control Centre (IOCC at terminal T3 of IGI airport) is that all Air India Flights operates smoothly and on time. The centre has connectivity with all operating bases of Air India throughout the world. Availability of Aircraft and Operating Crew including standby can be tracked by IOCC at least 72 hours in advance. Any issues in this regard are

being immediately resolved by the centre in liaison with the department concerned. Decisions with regard to any disruptive / cancelled flight are being taken in real time and communicated to concerned personnel.

As per the operating Captain, after landing in Jaipur, he made more than one call to IOCC, but did not receive any assistance.

(D) SUPERVISION & CONTROL OF THE OPERATION

Para 1.2 of the operations manual gives information about the supervision & control of the operations. Paragraph 1.2.3 – Operations Control states:

Company retains full responsibility (and accountability) for the overall operational control of each flight.

Operational control is defined as the exercise of authority (Within the context of operational control, authority is defined as the power or right to give orders, make decisions, grant permission and/or provide approval) to initiate, continue, divert or terminate a flight in the interest of the safety and security of the aircraft and its occupants.

In order to practically exercise operational control of flight operations Air India delegates the authority for the initiation, continuation, diversion or termination of each flight in the interest of the safety of the aircraft to the PIC as per DGCA requirements. Flight Dispatchers / Operations Controller work in conjunction with Air India's system of operational control in a support capacity.

PIC rated pilot with more than 500 hrs PIC experience (license/medical need not be current) can be nominated by General Manager (Ops.), as Designated Operations Controller, to exercise the functions of Operations Control. Operations Controller shall furnish the PIC, while in flight, with appropriate information that may be necessary for the safe conduct of the flight.

The Flight Dispatcher supports operational control by assisting the Pilot in carrying out such functions, duties or tasks such as pre-flight planning, load planning, weight and balance, delay, dispatch release, diversion, termination, etc by coordinating with the various agencies such

as Load control, Maintenance Control, Crew Control (Scheduling), ATC, Meteorological Communication, Commercial, Ground Handling, Cargo, etc.

Operations Controller shall support, brief, and/or assist the PIC and provide necessary assistance to PIC to decide over the initiation, continuation, diversion or termination of a flight. PIC and Operations Controller will communicate with each other on the operational information using VHF/HF or any means available throughout the duration of the flight.

While exercising the flight supervision and control, the Operations Controller shall render assistance/guidance to aircraft during emergency/abnormal operation. Flight Dispatch, shall also assist the Operations Controller in discharge of his duties as required.

En-route amendments to the OFP if required, must be coordinated and verified by means of relevant log under signature made by the operations controller, the relevant log also must contain a recorded agreement of the PIC.

A flight shall not continue towards the airport of intended landing unless the latest available information indicates, at the expected time of arrival, a landing can be made at that airport or at least one destination alternate airport.

Operations Controller with responsibilities for operational control need to have current and accurate information available, to allow informed decision making on completing the mission that would include at least:

- weather information, both en-route and at the airport of intended landing, to include hazardous phenomena such as thunderstorms, turbulence, icing and restrictions to visibility.
- be conversant with the Company's Aerodrome Operating Minima,
- field conditions, such as runway condition and availability and status of navigation aids.
- en-route navigation systems and facilities where possible failures might occur that could affect the safe continuation or completion of the flight.
- fuel supply, including actual en-route consumption compared to planned consumption, as well as the impact of any changes of alternate airport or additional en-route delays.

- aircraft equipment that becomes inoperative, which results in an increased fuel consumption or a performance or operational decrement, is to be considered and planned for, to ensure the aircraft makes a safe landing at an approved airport.
- Air traffic management issues, such as re-routes, altitude or speed restrictions and facilities or system failures or delays.
- security issues that could affect the routing of the flight or its airport of intended landing.

While exercising such functions, Operations Controller shall maintain liaison with other departments and perform functions in close coordination. **Operations Controller is responsible for disruption/ crisis management and to coordinate the activities of other interacting departments.**

There is no evidence to indicate that on the night of 05.01.2014, operations controller was available at Flight Dispatch as per the requirement laid down in OM(A) para 1.2.

(E) FLIGHT DISPATCH (OPERATIONAL CONTROL) MANUAL

The airline has issued Flight Dispatch (Operational Control) Manual Issue-3 Rev.0 dated 01st AUG 2013. Para 1.2.4 of the manual requires that:

- The Dy. General Manager (Flight Dispatch) at regions, shall ensure each Flight Dispatcher, prior to being assigned to operational control duties, holds a valid and current DGCA India approval as required for operations control.
- All the Flight Dispatchers shall meet all DGCA requirements, pertaining to age, knowledge, experience, training including Recurrent Training/Refresher and complete an observation flight or simulator observation.
- Duty Manager – Flight Dispatch, at each Flight Dispatch station shall ensure that personnel assigned for operational control functions hold valid flight dispatcher approval from DGCA and undergone refresher training as per training requirements.

(F) CENTRAL TRAINING ESTABLISHMENT, HYDERABAD

In order to appreciate the actions taken by the flight crew during the last phases of approach and landing and the role of flight dispatch including operations control during the flight, the Committee visited Central Training Establishment (CTE) Hyderabad which is the training centre for flight crew, Dispatchers etc. CTE is a certified Type Rated Training Organisation (TRTO) approved by the DGCA.

- Simulator training:

The committee members attended two simulator sessions, one that of the IR/PPC check and second for CAT II & III B evaluation. IR/PPC was conducted on Simulator I, which has been in service with Air India for more than two decades. Detailed discussions were also held with the simulator instructors regarding the quantum of training on particular emergencies and normal refresher.

- Technical Training:

There were 11 technical training instructors approved to impart technical training by the DGCA office. CTE has prepared a facility for “Computer based Training” (CBT) but the approval of the same is awaited from the DGCA.

- Performance Training:

CTE had 2 instructors for imparting the performance training on Airbus aircraft. As on the date of accident, none of these instructors were approved by the DGCA as A320 Performance instructors. Both are imparting training to flight crew for the last few years without the regulatory approval.

- DRM training:

DRM training was observed to be carried out by non- approved DRM trainers. During investigation, the dispatchers have provided copies of

the certificates for the various trainings undergone by them. While cross checking these with CTE, it was observed that there was mismatch.

(G) INFLIGHT PROCEDURE – FUEL MONITORING & DECLARATION OF EMERGENCY

Para 12.9.1 & 12.9.2 of the operations manual deals with the inflight procedures – fuel monitoring. As per these,

- Crew is required to periodically evaluate fuel remaining. Weather at the destination and designated alternate should be monitored. In case destination and alternate airfield become unavailable due to any reason, another alternate should be designated as the airport of landing. The diversion should be initiated at a time such that minimum of 30 minutes holding fuel is available at the alternate.
- During the flight, it will be necessary to monitor fuel usage and to record the fuel on board at stated intervals. The fuel remaining is to be compared against planned usage or against the amount of fuel required at destination as diversion fuel. Recording/Monitoring will be done by First Officer and reported to the Captain.

Para 12.9.3, deals with the low fuel state / declaration of emergency. As per this,

- The pilot-in-command shall divert to an alternate aerodrome, if an anticipated/ unanticipated circumstances may result in landing at the destination aerodrome with less than fuel required to divert to an alternate aerodrome plus Holding Fuel/ Final Reserve Fuel (Fuel to fly for 30 minutes at holding speed at 1500 ft (450 m) above aerodrome elevation in standard conditions). ATC must be informed about your intention well in advance, so as to get the necessary clearances. When in contact with the diversion airport, ATC must be informed about the fuel remaining on board in minutes.
- When the pilot calculates that any change to the existing clearance to the alternate aerodrome may result in landing with less than the holding fuel, the pilot-in-command shall advise ATC of a minimum fuel state by

declaring "**MINIMUM FUEL**" when, having committed to land at alternate aerodrome.

Planned first alternate for the flight was Lucknow and the second alternate was Jaipur. The aircraft arrived over Delhi Terminal Area with 4.6 tonnes of fuel as per CFP and the fuel required thereafter for diversion to Lucknow was 3.4 tonnes. The fuel required for diversion to Jaipur was 2.9 times. As per the crew statement they held in the Delhi Terminal Area for about 20-25 minutes thereby consuming around 1 tonne of fuel leaving around 3.6 tonnes of fuel. As per flight crew they commenced diversion to Jaipur when the fuel on board was 3.1 tonnes. After the accident the fuel on board was around 2.3 tonnes.

(H) SAFETY MANAGEMENT SYSTEM

The organisation SMS Manual has been approved by DGCA. The Corporate SMS is managed from Mumbai office. The two fleets SMS i.e. for narrow and wide body is separately implemented and the Safety Divisions of these two fleets manage the respective SMSs. The Pilot in Command, First Officer involved in the accident and few other officials mentioned they had not undergone any training on "Safety Management System" (SMS). Committee discussed the functioning of SMS at Delhi (Narrow body), Mumbai (wide body) and training (CTE, Hyderabad).

In the implementation of SMS in narrow body fleet, the Chief of Flight Safety (narrow body) is required to monitor the same in the organisation through inspections, training, hazard analysis, etc. Based on these reports, risk analysis is performed and mitigation actions are taken.

(I) EMERGENCY RESPONSE PLAN:

Emergency Response Plan (ERP) is managed from the corporate office at Mumbai and has a command centre at Mumbai (Kalina Office). On the day of the accident the ERP was not executed. The officials at Jaipur including the airport manager were not sure whether they had undergone

any training on ERP or any regular drills carried out to refresh their knowledge on the subject.

(J) FLIGHT PLANNING – FUEL & CREW COMPLIMENT

As per the para 10.18, of CIVIL AVIATION REQUIREMENT SECTION 3 - AIR TRANSPORT SERIES 'C' PART II, dated 1st MARCH, 1994 the operators, who do not have ILS Category IIIA/IIIB compliant aircraft in the fleet together with appropriately trained/ rated pilots, shall plan their Winter Fog Schedule to/from Delhi from 1000 hours to 2000 hours so as to avoid disruption of approved schedule.

As per CIVIL AVIATION REQUIREMENTS SECTION 8 SERIES 'O', PART II ISSUE I, 8th JULY, 2011, for flight preparation following fuel requirements should be considered

4.3 Flight Preparation

4.3.6 Fuel requirements

4.3.6.1 An aeroplane shall carry sufficient amount of usable fuel, to complete the planned flight safely and to allow for deviations from the planned operation.

4.3.6.2 The amount of usable fuel to be carried shall, as a minimum, be based on the following data:

- a) 1) current aeroplane-specific data derived from a fuel consumption monitoring system, if available; or
- 2) If current aeroplane-specific data is not available, data provided by the aeroplane manufacturer; and
- b) The operating conditions for the planned flight including:
 - 1) Anticipated aeroplane mass;
 - 2) Notices to Airmen;
 - 3) Current meteorological reports or a combination of current reports and forecasts;
 - 4) Air traffic services procedures, restrictions and anticipated delays; and
 - 5) The effects of deferred maintenance items and/or configuration deviations

1.17.2 INDIAN METEOROLOGICAL DEPARTMENT (IMD)

(A) IMD provides meteorological services to the civil aviation sector in fulfilment of the requirements prescribed by ICAO & instructions given by DGCA. These are provided through Aerodrome meteorological offices and aeronautical meteorological stations. The guidelines for meteorological service to aviation in India are given in “Manual on procedures for meteorological services for aviation in India” which is essentially ICAO Annex 3 with incorporation of national practices. The installation and maintenance of airport meteorological instruments are done by the surface meteorological division at Pune.

Route Forecast, aerodrome forecast, local forecasts and trend forecasts are issued by Aerodrome Meteorological Office (Office having forecasting facilities). During the closed hours of watch of the offices with restricted forecasting hours, the necessary forecasts are issued by the meteorological offices at state/regional centers.

In all Aerodrome Meteorological Office which are having forecasting facility, briefing is available to the pilots and /or flight operations personnel about the prevailing and anticipated weather conditions. Latest surface and upper-air synoptic charts, meteorological reports and forecasts of destination and its alternate(s), SIGMET information, AIREP, prognostic charts and ground based weather radar information should normally be displayed in meteorological Offices and made available for briefing & consultation.

In flight services provided are:

- Significant Meteorological (SIGMET) Information pertaining to the FIRs are issued by the Meteorological Watch Office (MWO) at Chennai, Delhi, Kolkata & Mumbai. These are supplied to the ATS units at the Flight Information Centre (FIC) and Area Control Centre (ACC) for transmission to aircraft in flight.

- Current Weather Reports, Aerodrome Forecasts and SIGMETs of certain stations are broadcast on HF from Kolkata and Mumbai at half hourly intervals. (VOLMET BROADCAST)
- Latest Weather Report of the airport, together with trend forecast valid for the next 2 hours, is included in the Automatic Terminal Information Service (ATIS) broadcast from Chennai, Delhi, Kolkata & Mumbai.

Further as per ICAO Annex 3 SARP's, in India the trend for visibility is issued when, "Visibility is expected to deteriorate and pass through one or more of 150, 350, 600, 800, 1500 or 3000 m. When significant numbers of flights are conducted in accordance with the visual flight rules, the forecast shall additionally indicated changes to or passing through 5000 m".

As per AIP India, the meteorological office is required to make arrangements with the appropriate ATS unit to ensure that the ATS unit relay without delay:

- Routine and special air-reports by voice communications to their associated meteorological watch office.
- Routine air-reports by data-link communications to WAFCs; and
- Special air- reports by data-link communications to their associated meteorological watch office and WAFCs.

(B) Though IMD provides meteorological services to the civil aviation sector in fulfillment of the requirements, DGCA has issued CAR under section 9, series M, part I for provision of Meteorological services for International Air Navigation to ensure the flow of information/data necessary for the safety, regularity and efficiency of international air navigation. Following are the relevant paragraphs for the present purpose:

4.1.4 IMD shall establish a mechanism for its aeronautical meteorological stations to be inspected at sufficiently frequent intervals to ensure that a high standard of observations is maintained, that instruments and all their indicators are functioning correctly, and to check whether the exposure of the instruments has changed significantly.

- 4.1.6 At aerodromes, with runways intended for Category I instrument approach and landing operations, automated equipment for measuring or assessing, as appropriate, and for monitoring and remote indicating of surface wind, visibility, runway visual range, height of cloud base, air and dew-point temperatures and atmospheric pressure should be installed to support approach and landing and take-off operations. These devices should be integrated automatic systems for acquisition, processing, dissemination and display in real time of the meteorological parameters affecting landing and take-off operations.
- 4.2 An agreement between the IMD and the ANSP should be established to cover, amongst other things
- a) the provision in air traffic services units of displays related to integrated automatic systems;
 - b) the calibration and maintenance of these displays/ instruments;
 - c) the use to be made of these displays/instruments by air traffic services personnel;
 - d)
- 4.6.3.5 The units providing air traffic service and aeronautical information service for an aerodrome shall be kept informed without delay of changes in the serviceability status of the automated equipment used for assessing runway visual range.
- 11.6 Use of aeronautical broadcasting service — contents of VOLMET broadcasts
- 11.6.1 Continuous VOLMET broadcasts, normally on very high frequencies (VHF), shall contain current METAR and SPECI, together with trend forecasts where available.
- 11.6.2 Scheduled VOLMET broadcasts, normally on high frequencies (HF), shall contain current METAR and SPECI, together with trend forecasts where available and, where so determined by regional air navigation agreement, TAF and SIGMET.
- (C)** The committee visited Jaipur airport to have an overview of the meteorological infrastructure available there. All areas of the airport were visited and it was

observed that the ILS critical area was not protected nor was any cautionary message for ground crew displayed to avoid the critical areas.

Further the RVR equipment at Jaipur was not calibrated as per the laid down requirements.

(D) DGCA CARs covering MET information

During the course of investigation the committee reviewed the contents of the following CARs which were found relevant to the accident and with reference to “Runway Visual Range”. Following are the excerpts:

CAR Section 9, Series M, Part I,

Para 2.1.4 Indian Meteorological Department (IMD) shall provide Meteorological Services for Safety, regularity, and efficiency of International air navigation in accordance with provisions of this CAR -----.

Para 4.6.3.2 Runway Visual Range as defined in this CAR should be assessed on all runways intended for use during periods of reduced visibility, including:

- a) Precision approach runways intended for Category I instrument approach and landing operations; and
- b) Runways used for take-off and having high-intensity edge lights and/or centre line lights.

CAR Section 8, Series O, Part II,

Para 4.2.8.5 Recommendations: For instrument approach and landing operations, aerodrome operating minima below 800 meters visibility should not be authorized unless RVR information is provided.

CAR Section 8, Series C, Part I,

Para 4.9 Conversion of Reported Meteorological Visibility to RVR/CMV: All Weather Operations Explanatory Material (Annexure 2)

CMV is not to be used for calculating any established RVR minima below 800 m (e.g. if the reported visibility is 700 m, then CMV is not to be used for established RVR minima below 800 m). CMV is meant to be used by pilots in flight **and not as a planning tool for dispatch of a flight.**

The committee deliberated on the contents of the CARs quoted above and came to a conclusion that though the responsibility of providing RVR rests with IMD, but in actual practice, instrument RVR facility is not available wherein operations are being conducted into airports where there are:

- a) Precision approach runways intended for Category I instrument approach and landing operations; and
- b) Runways used for take-off and having high-intensity edge lights and/or centre line lights.

Due to lack of RVR facility at airports and to enhance the flexibility in operations, DGCA has permitted the flight crew to convert the existing visibility into RVR by applying formulae with approach lights length of 420 m.

The ICAO Aerodrome Meteorological Observation and Forecast Study Group (AMOFSG) (Ref AMOFSG/10-SN No.11) identified inconsistencies between the Manual of All Weather Operations (Doc 9365) and Conversion of Reported Visibility to an equivalent Runway Visual Range/Converted Meteorological Visibility (RVR/CMV). The summary of the report states the following:

*Visibility is defined by the Annex 3 since 2001. The definition considers the presence of lights of 1000 cd. The updated version of the ICAO Manual of All-Weather Operations, Doc 9365, introduces a conversion of Reported Meteorological Visibility into CMV, for Converted Meteorological Visibility, a value equivalent to a RVR, when RVR is not available. The conversion table used for that purpose is not consistent with the current definition of visibility. It is consistent with a visibility being a MOR (Meteorological Optical Range). **This conversion could lead to safety problems.***

Further **CAR Section 8, Series C, Part I, Para 14 “Aerodrome Operating Minima-Take Off” Table 10** refer to **Vis/RVR**, the said table is ambiguous as at most airports in India wherein RVR facility is not available the aircraft are departing with visibility of 400 m. Whereas as per **CAR Section 8, Series O, Part II, Para 4.2.8.5** whenever the visibility is below 800 m, RVR is to be reported.

1.18 Additional information

1.18.1 BEA France Report (Airbus report)

The SSDFDR raw data was sent to the BEA for their review and comments. The flight crew was cleared by ATC on the ILS approach runway

27 (CAT1). ILS approach was performed with dual AP until 200 ft RALT. Then AP was disconnected and the Captain performed the final approach manually. A report (Airbus report) was received and salient information from the report is as follows:

QUOTE

(ALL TIMES IN UTC)

At 15:38 the aircraft was in approach toward runway 27 (QFU 265°) of Jaipur airport, crossing 800ft RALT in the following conditions:

- ✚ Dual AP were engaged in G/S - LOC modes,
- ✚ A/THR was active (managed speed mode)
- ✚ Target speed was Vapp at 141kts (VLS estimated at 127kts).
- ✚ CONF FULL
- ✚ Auto-brake LOW armed
- ✚ ILS approach (CAT I)
- ✚ No wind
- ✚ GSI 420.1242/14 (TL) 1-Sep-14 10/25

At 15:38:44 the aircraft was passing 200ft RALT, APs were disengaged (Captain was PF). FD and A/THR remained engaged. At this time, A/C was on its Glide and LOC paths.

At 15:38:54 at 75ft RALT:

- ✚ On the longitudinal axis, the Captain applied two successive back stick inputs (5.5° and 7°). The pitch increased up to 5.5°.
- ✚ On the lateral axis, aircraft was aligned with runway axis, left roll was commanded on captain stick leading left roll to increase. In the meantime, a progressive right rudder pedal input was applied.

From 15:38:58 (23ft RALT) to 15:39:08 (just after touchdown),

TLA were progressively retarded and reached IDLE just after touchdown. The increase of pitch led to a slight decrease of the aircraft speed. The A/THR, which was still active, commanded

an increase of the thrust to maintain the target speed. The aircraft floated above the runway at around 17ft during 7sec. On lateral axis, the Captain applied successive right and left sidestick inputs (high activity on the stick) with predominance on the left (up to full left order), increasing the left roll (up to 10° at 7ft RALT). In the mean time the right rudder pedal input was accentuated (up to 27° right order).

These inputs led the aircraft to deviate to the left of the runway with a drift angle of 8° just before touchdown.

At 15:39:04 the aircraft was at 17ft RALT, a back stick input up to 12° led the pitch to increase to almost +6.5°.

AT 15:39:07 aircraft touched down on the left Main L/G with CG at 46m on the left of the runway axis and about 1000m after the runway threshold with:

- ✚ Max recorded Vertical Acceleration (VRTG) = 1.39G,
- ✚ +5.6° of pitch,
- ✚ 9.5° of left roll,
- ✚ Max recorded Lateral Acceleration (LATG) = 0.35G leftward.

At 15:39:08 ground spoilers deployed. Captain Sidestick was deflected full left. Roll decreased to 0° and then increased to 3° left. Rudder pedals were released then deflected up to 37° right order. Aircraft continued deviating leftward but LATG increased to 0.44G leftward, meaning that the aircraft was skidding to the left.

At 15:39:10 nose squat was recorded compressed. Rudder pedals were released then deflected up to +16° left order. Left brake pedal deflected up to 70°. In the meantime, LATG changed from 0.44G leftward to 0.15G rightward. Aircraft stopped skidding to the left and started to come back to the runway. Aircraft left Main L/G reached about 80m from runway axis (maximum deviation).

At 15:39:12 MAX REV was selected and rudder pedals were then deflected to 13° right order. Aircraft kept on coming back toward runway. Both brake pedals were deflected with more braking on the left (up to max brake pedal deflection) than on the right.

At 15:39:14 LATG increased from 0.08G leftward to 0.23G rightward. Longitudinal acceleration (LONG) increased from +0.40G to +0.69G. Immediately after that aircraft deviated to the left. At this time, CG was about 60m from runway axis and left wing tip was about 77m from runway axis. It is therefore probable that the left wing collided with a tree located about 73m from runway axis. GS was recorded at 109kt. Left aileron became invalid. 2 seconds later, normal law reverted to alternate law. During the deceleration, VRTG varied between 1.86G and 0.52G. The aircraft then came back on the pavement and stopped at the left edge of runway.

The crew performed go around at Delhi and had concerns of low fuel and bad weather conditions. The first alternate on the CFP was Lucknow and second Jaipur. The Airbus computations for Lucknow and Jaipur are as follows: (The aircraft had 2.3 Tons of fuel after it came to final halt at Jaipur.)

Lucknow	Jaipur
- Distance (from DEL): 233NM	- Distance (from DEL): 127NM
- Estimated Trip Fuel : 2110kg (CRZ FL140)	- Estimated Trip Fuel : 1220kg (CRZ FL140)
- Estimated FOB : 1490kg at Destination	- Estimated FOB : 2380kg at Destination
- CAT II approach capability (RWY 27)	- CAT I approach capability (RWY 27)

2.0 ANALYSIS

2.1 Airworthiness & Serviceability of aircraft

Certificate of Registration, Certificate of Airworthiness, Aero Mobile Licence & Certificate of Release to Service in respect of the aircraft were valid. The aircraft and its Engines were being maintained as per the approved maintenance program consisting of calendar period/ flying Hours. The Noise Certificate for the aircraft was current. The Centre of the Gravity (CG) of the aircraft was within limit.

The aircraft has flown 55705:35 airframe hours since new and 5351:33 airframe hours since issue of last Certificate of Airworthiness. Since new, engine no. 1 & 2 has logged 47501.55 & 48258.19 hours respectively. The last major inspection '3A' Check was carried out on the Aircraft on 24.11.2013 at 55305:56 Flight Hours. Subsequently all lower inspections and pre flight checks, were carried out as and when due before the accident.

Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine has been complied with. No snag was pending for rectification before the accident flight nor was any repetitive defect entered in the logbook of the aircraft.

Flight crew has not discussed any malfunction of any of the systems during flight nor has entered any operational snag after the flight.

2.2 Flight planning, supervision & control

2.2.1 Role of Operations Control

As brought out earlier in the report PIC rated pilot of the organisation with more than 500 hrs PIC experience (license/medical need not be current) can be nominated by General Manager (Ops.), as Designated Operations Controller, to exercise the functions of Operations Control. Operations Controller is required to be available at Flight Dispatch and he shall furnish the PIC, while in flight, with appropriate information that may be necessary for the safe conduct of the flight. However, the Investigation

team observed that on the date of accident, no Operations Controller was available at Flight Dispatch, Delhi.

2.2.2 Role of flight dispatch

From the documentation and discussions with the flight dispatch personnel, it could not be established that who had dispatched the flight from Delhi to Guwahati. There were three personnel in the morning shift and the individual who had prepared the FWz Operational Flight Plan could be identified but Committee could not find any record indicating who finally dispatched the aircraft. No signatures of flight dispatcher were available in the dispatch register in the column provided.

Further, there is no systematic process of hand over and takeover of the shift and the briefings are all verbal and not documented. The Flight Dispatchers & Flight Crew was not aware of the requirement of “PLANNING MINIMA REQUIRED FOR EN-ROUTE/ DESTINATION ALTERNATE” nor was it followed. Keeping the weather trend of Jaipur under watch, flight dispatch proactively should not have filed Jaipur as an alternate.

The Flight Dispatch did not make any effort to update the flight crew with latest destination & alternate weather especially after the issue of 0900 UTC Delhi TAF which clearly mentioned that by time 1500-1600 UTC of 5th of January, the visibility would have dropped to 0200 meters, when this is read in conjunction with the METARS (1130 UTC onwards) which indicate outside air temperature & Dew point merging, the visibility/ RVR was bound to drop rapidly after sunset.

During the course of interview with the Flight Dispatchers committee was given to understand that the existing “Narrow Body” HF sets were unserviceable and the aircraft could only contact Delhi dispatch while in VHF range between (100-150 nms) from Delhi.

Following are the additional observations:

- There is no company policy on pilot “Self Dispatch”.

- Flight Dispatchers are not provided with approved training for the FWz “Flight Planning” system. Nor could any proper training records be produced.
- Flight dispatchers are not licensed
- There was no Flight Following provided to the flight.
- It was observed that the flight dispatchers were undergoing DRM once every 24 months against a requirement that it should be carried out every year.
- Not all flight dispatchers had undergone training on SMS.
- Some of the flight dispatchers on duty on the night of 5th of January had lapsed refresher of A320 aircraft

Scrutiny of the Operational Flight Plan revealed that the flight was planned with scheduled arrival in Delhi at 2040 hrs. IST (1510Z) It is evident that the said set of flight crew were not CAT III A/ III B rated therefore they must not have been scheduled to operate the return leg of the flight to Delhi from Guwahati. This is not in line with the DGCA CAR on the subject.

2.3 Role of ATC units

ATC units like Delhi, Hyderabad Mumbai, Chennai, Kolkata, Varanasi, Nagpur & Mangalore play a vital role in managing the traffic flow across the country. In the recent past the Air Traffic Management (ATM) has improved. As per the DGCA requirement laid down in the AIC 11 of 2009 “Guidelines for Aircraft Operations During Low Visibility Conditions at IGI Airport” (Para 27), the committee believes that ATC (Delhi) should have informed all airports that (for all flights departing these airports with destination as Delhi & with a flight time of more than 2 hours) the estimated landing time and expected delay. Similarly in this particular case ATC Guwahati & Varanasi could have advised the aircraft of the deteriorating weather conditions at Delhi & Jaipur in light of the TAF issued by Delhi Met office of 0900 UTC.

DGCA CAR Section 9, Series M Part 1 (Para 11.6.1) requires that “Continuous VOLMET broadcasts, normally on very high frequency (VHF) shall contain current METAR & SPECI, together with trend forecast where available. Currently no such facility exists in India.

Further the para requires that “Continuous VOLMET broadcasts, normally on very high frequency (HF) shall contain current METAR & SPECI, together with trend forecast where available. Such facility use to exist in Delhi but has been withdrawn a few years ago and is no more available.

The flight crew therefore was duty bound to seek weather update from ATC units and plan well in advance a course of action in case the weather goes below minima. As per the company SOP’s, the flight crew is supposed to keep themselves updated with latest destination & alternate weather.

2.4 Meteorological Aspects

The current & forecast meteorological information is available on IMD website and through on line briefing system of Airport Meteorological Office, which provides information on weather forecast for six hours, current weather and visibility of IGI airport and weather information of alternate airport(s).

With the deteriorating trend of visibility detected at IGI airport, Duty Officer MET, IGI airport, is required to inform the WSO and to the Airlines and other agencies whenever enquiries about visibility conditions are received from Airlines to plan their flight scheduling. However as per records available, this information was neither obtained nor used for planning purposes.

2.4.1 Weather Conditions vis-a-vis flight progress

The following table gives the position of the aircraft and corresponding weather at three places i.e. destination, 1st alternate and 2nd alternate.

Time of observation (UTC)	Position of aircraft	Delhi	Alternate		Approx Location	Possible assistance from ATC unit	Possible Company assistance
			Lucknow	Jaipur			
		Vis/ RVR, Temp/Dew Pt (Mtrs/Mtrs, °C/°C)					
1130	On ground	250/28-850 15/15	3000 20/14	3000 18/13	Guwahati		Company info
1200	In flight	250/28-750 14/14	2500 20/13	Not issued	Near Baghdogra		Company HF

1230	In flight	200/28-1000 13/13	2500 19/13	2000 16/14	Near Patna	Kolkata Control	Company HF
1300	In flight	150/28-900 13/13	2000 18/13	Not issued	Between Patna- Varanasi	Varanasi Control	Company HF
1330	In flight	150/28-1150 12/12	2000 17/13	1500/27-2000 14/14	Near Varanasi	Varanasi Control	Company HF
1400	In flight	100/28-850 12/12	2000 17/14	Not issued	Near Lucknow	Varanasi Control	Company HF
1430	In flight	050/28-800 11/11	2000 16/14	0900/27-1500 13/13	Approach area-Delhi	Delhi Control	Flight Dispatch 130.7 Mhz
1500	In flight	NA	2000 16/13	0900/27-1300 13/13	Approach area-Delhi	Delhi Approach/Control	Flight Dispatch 130.7 Mhz
1517 (SPECI)	In flight	Not issued	Not issued	0400/27-1000 13/13	Diverted to Jaipur	Delhi Control	Flight Dispatch 130.7 Mhz
1530	In flight	000/28-450 09/09	2000 15/13	(1526Z) 050/27-200 13/13	Approach at jaipur	Jaipur Approach	Company HF
15:39:07					TIME OF ACCIDENT		
1600	In flight	000/28-450 08/08	NA	Not issued			
1630	In flight	000/28-400 08/08	1500/27-2000 15/13	000/27-150 13/13			
1700	In flight	0000/28-050 08/08	NA	Not issued			

1715 (SPECI)	In flight	Not Avbl	500/27- 1400 14/13	Not issued			
1730	In flight	000/28- 050 08/08	500/27- 1400 14/12	000/27- 125 12/12			

So the last 2 columns of the above table indicates the opportunities which were available to amend the progress of flight and avoid ultimate culmination into the accident. Further the Committee studied the Jaipur TAFs & METARs and observed that there were issues with the observations made in TAF and METAR. The value as given in TAF & those given in METAR were not compatible with each other.

2.4.2 Regulatory requirements & Corresponding Provisions

DGCA has issued guidelines for aircraft operations during low visibility conditions at IGI airport Delhi whereby IMD is required to provide MET forecast at 0600, 1200 and 1800 UTC for fog on their website along with instantaneous RVR for runway 27, 11/29. RVR for runway 28 is provided on continuous basis with 30 minutes update on the website.

The guidelines also requires that with the deteriorating trend of visibility detected at IGI airport, the WSO is informed when the RVR becomes less than 1200 meters and also when the visibility forecasted indicates deterioration of visibility to 800 meters or less. WSO on receipt of visibility reports, and at the appropriate time is required to ensure broadcasting on ATIS, whenever CAT II and CAT III-A/B conditions are in vogue. The Airlines are required to plan their departures and arrival at IGI airport on the basis of the above information. Further all airlines are required to monitor this trend through telephone or the ATIS broadcast for their planning of flight departures and passenger facilitation.

IMD is also required to establish a mechanism for its aeronautical meteorological stations to be inspected at sufficiently frequent intervals to ensure that a high standard of observations is maintained, that instruments

and all their indicators are functioning correctly, and to check whether the exposure of the instruments has changed significantly.

2.4.3 Was available meteorological information utilised

The last 2 columns in the table given at point 3.1 indicate the possible assistance regarding weather or otherwise which could have been provided by ATC unit or by the organisation. It can be seen that there were ample windows of opportunity where either flight crew could have been vigilant or advise could have been provided by the ground units to the flight crew whereby action should have been taken by the flight crew to divert to Lucknow (1st alternate). This could have avoided the emergency situation and thereby the accident. It can be said that despite the system and procedures laid down in the Manuals, the available information was not utilised in this particular case for safe conduct of flight. The safest bet was to land at Lucknow on the route to Delhi or return back to Lucknow after assessing the situation particularly in view of the fact that the co-pilot was not having clearance to land in CAT II/III conditions.

2.4.4 IMD office at Jaipur

Personnel handling Jaipur Meteorological office at airport were not very much conversant with the procedures for giving RVR. It was informed that the persons who were trained on the equipment were transferred out of airport office. The periodic calibration of the equipments was also not carried out due want of agreement with the manufacturer at the time of installation. No NOTAM was issued regarding RVR equipment not being calibrated as per Para 4.6.3.5 of CAR section 9 series M part I.

Further, the ILS critical area was not protected nor was any cautionary message for ground crew displayed to avoid the critical areas

2.5 Flight Crew

2.5.1 Qualifications

Both the flight crew were having valid ATPL with appropriate endorsements of aircraft. They possessed all the necessary documents as

required by the regulations. Their Medical check was valid and without any conditions.

2.5.2 Flight Planning

Flight Planning is an art and it involves participation of both Flight Dispatcher & Flight Crew. Flight Dispatcher is required to plan the flight keeping various factors like type of aircraft, weight, departure station, en-route alternates & destination weather, ISA Conditions etc. in mind. Planning normally starts the previous night for the next day's morning departures. "Narrow Body" aircraft of the operator was traditionally using the "Seasonal Wind Operational Flight Plans" and had moved on to using the "Computerised Operational Flight Plan" (FWz). Flight crew is required to check the accuracy of the flight plan as mentioned in the "Airbus Normal Operating Procedures" for errors. In this case the flight crew accepted a flight plan which was of a different registration, thereby rendering the flight plan not usable as the "Performance Factor" varies from aircraft to aircraft. The fuel on board would not be accurate as the "Route Reserve" for a computerised flight plan (3%) is less than the route reserve for a seasonal wind flight plan (5%).

During the course of investigation and discussions with flight dispatchers, it came to light that most flight dispatchers had not undergone any specific training for preparation of the Flight Plans.

2.5.3 Training

As per the PIC, he has not carried out any Cat-II or Cat-III ILS practice approach during last 6 months. He has undergone last simulator check in September 2011 wherein only one Low Visibility approach was carried out. Jaipur was below CAT I minima and the PIC has used his emergency authority, to make an approach below minima. He also informed that he has not undergone any training on Safety Management System (SMS). The flight crew was not aware of a safety policy of the company.

2.6 Crew Resource Management (CRM)

By definition “CRM” is utilisation of all available resources by a set of flight crew (comprising of two or three individuals) for a safe conduct of flight. While interacting with senior trainers at CTE, it came to light that none of the CRM instructors imparting CRM training in “Narrow Body” had DGCA approval nor have undergone any specialised training in this regard.

Going by the contents of the CVR, in relation with the concepts of Inquiry, Advocacy, Communication, Situational Awareness, Decision Making & Error Chain etc., the flight crew did not exhibit skills learned in CRM training. Flight crew did not utilise their available resources effectively.

2.7 SMS including ERP

The organisation SMS Manual has been approved by DGCA. Based on the inspections, hazards reported and other inputs, risk analysis and mitigation action are taken, however barring the fulfilment of regulatory requirements in this regard, no specific risk analysis was carried out for the procedural and systemic changes introduced in the organisation. In the implementation of SMS in narrow body fleet, the Chief of Flight Safety monitors the same in the organisation. At implementation level, there was no visible methodology adopted to ensure that individuals are imparted initial & recurrent training as per the requirements.

PIC in his statement mentioned that he had personally called IOCC and advised them that they had crash landed at Jaipur but in spite of this information ERP was not executed. The officials at Jaipur including the airport manager were not sure whether they had undergone any training on ERP or any regular drills carried out as stipulated.

2.8 Inflight Fuel Monitoring

Review of the copy of the used operational (computerised) flight plan by the flight crew, it is observed that the flight crew had not carried out the necessary fuel cross check after every 30 minutes as required by OM(A) para 12.9. However the flight crew during the post accident discussions informed

that the same was carried out. Evidence of the same could not be produced by the flight crew.

The flight crew had not declared “minimum fuel” either to Delhi ATC or Jaipur ATC while diverting.

2.9 Previous Fuel emergency cases

It was observed that across the airlines there have been instances of declaration of fuel emergencies by the pilots. These instances have been investigated by the respective airline permanent investigation boards wherein Air Safety Directorate of DGCA acts as observer. These investigation reports carry various recommendations to obviate such occurrences in future and these are applicable to the individual organisation. Copies of these investigation reports are forwarded to DGCA both at regional and headquarters level.

The availability of safety data to the State is a determinant factor in the selection of quantitative or qualitative safety indicators. Incidences of fuel emergencies are one of the vital safety indicators. As per the State Safety Programme of DGCA, India the safety data shall be used to target oversight on areas of greater concern or need. DGCA receives information through MORS & VRS. Further there are recommendations contained in the incident/accident investigation reports and findings in the surveillance reports. In addition information on the operational exceedance is also available from the Flight Operations Quality Assurance (FOQA) programme/ Flight Data Monitoring (FDM). It can be safely presumed that sufficient information is available on the fuel emergency as a safety indicator. The available data could have been utilised in a better manner.

2.10 Sequence of events (including DFDR & CVR analysis)

During departure from Delhi the flight crew was not CAT II/III compliant to operate the last leg of the series of flight i.e. Guwahati-Delhi. Jaipur could not have been filed as an alternate due weather (temp/dew point) and weather trend from the TAFs available at that time. Before dispatching the

aircraft from Delhi, the Flight Dispatch has not given additional fuel for the purpose of anticipated delay due ATC requirements for the return leg i.e. Guwahati to Delhi as per the regulations. Though the flight was dispatched from Delhi and the remaining sectors were self dispatch sectors, there is no procedure laid down for self dispatch.

Weather trend of Jaipur, Delhi & Lucknow should have been reviewed by the flight crew while departing from Guwahati for Delhi. Though 500 kgs of extra fuel was uplifted by the Captain but there was no feedback from the flight dispatch or ATC to captain on the anticipated delay. While crossing Varanasi Control neither the VHF VOLMET was available nor crew has asked Delhi Jaipur and Lucknow weather.

Lucknow was the first designated alternate and had serviceable CAT II ILS facility available. Crew has not utilised “updated Lucknow weather” with the help of Lucknow ATIS to decide further course of flight.

In view of the fact that crew compliment was not CAT II/ III compliant, and the weather minima deteriorating below CAT I, the flight crew on the first instance should have diverted to Lucknow for which they had adequate fuel on board. Approach should not have been initiated into Delhi with RVR fluctuating toward the lower end of CAT I conditions for runway 28. Runway 29 was already below minima. Crew has not asked Delhi ATC for Jaipur and Lucknow weather.

Flight dispatch of the airline relayed to the aircraft Jaipur METAR which was 2 hours old indicating that visibility at Jaipur is 2000 m which prompted the flight crew to have false picture of Jaipur weather.

At the time of diversion to Jaipur, the aircraft had 3.1 tonnes of fuel on board which was adequate to divert to Lucknow which was the 1st alternate. The aircraft after commencing missed approach at Delhi was around 40 Nm west of Delhi. The incorrect weather information provided to flight crew prompted them to continue towards Jaipur which at that point of time was

closer than Lucknow, however flight crew had not made any effort to check the weather with ATC Jaipur.

Once the crew was made aware of the rapidly deteriorating weather conditions (visibility/ RVR) at Jaipur, no discussions were held between the flight crew regarding diverting to Udaipur, Jodhpur or Ahmedabad.

No discussions were held between the crew to conduct an auto land once ATC advised them regarding visibility/ RVR going below CAT I minima when the flight crew committed themselves to land at Jaipur.

Flight crew continued to use the landing lights, which in such low visibility conditions impairs the forward vision. This probably contributed to the late sighting of the approach and runway lights by the flight crew, though there exists instructions in the organisation to keep the landing lights OFF for landing in low visibility conditions.

The PIC disengaged the auto-pilot at 200 feet. At 75 feet RA on the longitudinal axis, the Captain applied two successive back stick inputs (5.5° and 7°). The pitch increased up to 5.5° . On the lateral axis, aircraft was aligned with runway axis, left roll was commanded on captain stick leading left roll to increase. In the meantime, a progressive right rudder pedal input was applied.



The decision of PIC to disengage the autopilot was the last inappropriate act which caused the aircraft to deviate to left from localiser resulting in the aircraft landing (with both landing gears) on the soft ground.

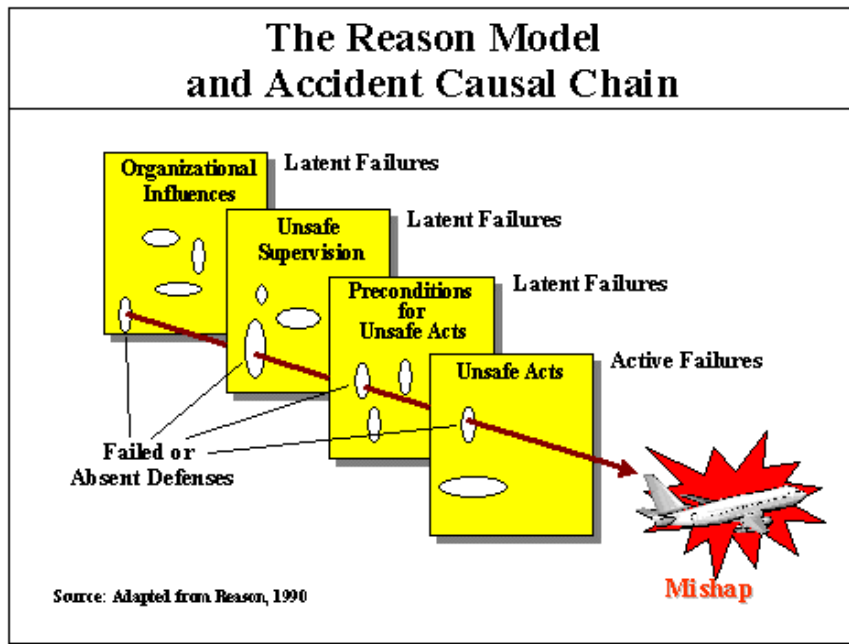
The increase of pitch led to a slight decrease of the aircraft speed. The A/THR, which was still active, commanded an increase of the thrust to maintain the target speed. On lateral axis, the Captain applied successive right and left side stick inputs (high activity on the stick) with predominance on the left (up to full left order), increasing the left roll (up to 10° at 7ft RALT). In the mean time the right rudder pedal input was accentuated (up to 27° right order). These inputs led the aircraft to deviate to the left of the runway with a drift angle of 8° just before touchdown. TLA were progressively retarded and reached IDLE just after touchdown.

3.0 CONCLUSIONS

3.1 FINDINGS

In the previous sections the Committee has put forward the factual state of affairs as existing in the flight operations department of the operator on the date of accident and tried to analyse the same particularly for the actions or inactions which could have acted as precursor to the accident.

In the following section an attempt has been made to give systematically the identified active and latent failures within the functioning of various departments which, it is felt culminated into the accident. The approach is based on Human Factors Analysis and Classification System (HFACS) which is a broad human error framework to investigate and analyse human factors aspects. It is based upon James Reason's SWISS cheese model of accident causation. The aim is not to attribute blame but is to understand the underlying causal factors that lead to this accident.



3.1.1 General

- The operator was carrying out operation of aircraft under SOP and the maintenance of aircraft under CAR 145.
- The Certificate of Airworthiness, Certificate of Registration and Certificate of Release to Service of the aircraft was valid on the date of the accident.
- The defect records were scrutinized and there was no defect pending on the aircraft prior to the flight which could have contributed to the accident.
- The PIC & the co-pilot were holding valid license on the type of aircraft. Both the crew members held valid medical certificates as per the requirement.
- The crew had undergone pre-flight medical examination at Delhi and nothing abnormal was observed. The BA test was negative.
- All major modifications and Service Bulletins were complied with. There was no snag pending for rectification before the accident flight.
- The visibility at the time of landing was almost nil.
- The fuel remaining on board was 2400 kgs.
- There was no fire during or after the landing hence the flight crew never considered an emergency passenger evacuation.

- The disembarkation of passengers was carried out on the runway. One passenger suffered minor bruise on the knuckle of his right hand middle finger. He was attended to by the cabin crew in the aircraft and also by the doctor at the airport.
- Post flight medical check-up of all the crew members including breathalyser (BA) test was done by the medical officer, M.I. room Jaipur airport. The BA test was negative for all the crew members.
- Since the aircraft was obstructing the runway, the airport was shut down for any further flight operations till the runway could be cleared.
- Damage to the aircraft (port wing) was not reported by the flight crew in the tech log.

3.1.2 Organizational influences

- The Commander was CAT III qualified and the First Officer was only CAT I qualified.
- Though the FWz plan was prepared for VT-ESL but later on the aircraft was changed to VT-ESH and the FWz plan as prepared for VT-ESL was used. The whole purpose of preparing aircraft specific flight plans is defeated.
- From Delhi only first leg i.e. Delhi-Guwahati was dispatched and for the remaining sectors which were self briefing sectors flight plan and NOTAMs were given to the flight crew. There was no document to indicate the procedures to be adopted for self briefing.
- No blood or urine sample was taken for the flight crew after the accident.
- There was no disabled aircraft removal plan for Jaipur airport nor are there appropriate equipments available for removal of disabled aircraft.
- ILS critical area at Jaipur was not protected nor was any cautionary message for ground crew displayed to avoid the critical areas.
- The RVR equipment was not calibrated as per the requirements. No NOTAM was raised in this regard.
- No Operations Controller was available on the night of 5th January 2014.

- The Flight Inspection Directorate of DGCA has carried out surveillance checks and audits of the organisation including their flight operations. Findings observed during investigation either do not exist in these reports or there was lack of effective action on the findings.

3.1.3 Unsafe supervision

- No flight following was provided either by flight dispatch or the IOCC.
- Weather updates were not asked by the crew from the flight dispatch nor were any updates provided by Flight dispatch to the aircraft during the flight except when crew had asked Delhi dispatch about Jaipur visibility before finally diverting to Jaipur.
- Commander after the accident contacted the operator's IOCC more than once but Emergency Response Plan was not activated.

3.1.4 Preconditions for unsafe acts

- At Delhi the flight was no. 12 in the sequence (for landing) and continued to remain in the holding pattern for the next 20-25 minutes. During this period there was no attempt on the part of flight crew to seek Lucknow weather nor has Flight dispatch of the operator given any advice to the flight about Jaipur or Lucknow weather.
- At the time of initiation of diversion to Jaipur, the flight Dispatch had provided visibility of Jaipur as 2000 m which was two hours old. At this stage the crew has not checked complete weather of Jaipur.
- Another scheduled flight ahead had carried out a missed approach and diverted to Ahmedabad whereas the accident flight continued approach to Jaipur.
- The aircraft was flown on managed speeds. The fuel was checked visually on the Flight Management System (FMS) and Fuel Page which was further cross checked with the OFP planned figures by the crew on way points but was not recorded on the Operational Flight Plan.
- There was no briefing about traffic congestion over Delhi by any of the enroute ground stations both of the AAI and the operator.

- The weather (visibility / RVR) reported on Runway 29 was below CAT I conditions and during hold, the RVR of runway 28 also dropped below Cat. I minima and was fluctuating.
- Though the planned 1st diversion alternate was Lucknow which had visibility of 2000 m i.e. above minima, but the crew decided to divert to Jaipur as after missed approach the aircraft was close to Jaipur and Dispatch had provided visibility of Jaipur as 2000 m. At this stage the crew has not checked complete weather of Jaipur and at no stage the flight crew realized that the outside air temperature and dew point being the same, the visibility / RVR would drop rapidly, especially after sunset.
- Minimum diversion fuel to Jaipur was calculated as 2.9 tonnes as per FWz flight plan and the actual “Fuel on Board” was 3.1 tonnes.
- At 68 DME from Jaipur, the crew monitored the complete ATIS weather of Jaipur i.e. visibility of 900 m, Dew Point as 13°, temperature as 13°, and RVR of 1000m.
- When the aircraft was at 25 DME, from Jaipur, ATC advised that the weather was deteriorating fast and visibility was 400 meters. The crew however intimated the ATC that they were committed to land at Jaipur due fuel. Fuel on board at that point of time was 2.6 tonnes approx which was adequate to divert to Jodhpur, Ahmedabad, Delhi or Udaipur (if available).
- Approach was commenced for Jaipur with a visibility of 500 meters with trend reducing.
- From the “Arrival Route” the flight flew the VORDME arc for ILS runway 27. The ATC has transmitted the RVR as 200 m and visibility as 50 m with trend reducing.

3.1.5 The accident

(Following information is corroborated with the Airbus DFDR analysis report)

- When the aircraft was above MDA (1480 feet AGL), ATC reported RVR 50 m and cleared the aircraft to land subject to minima. Both the flight crew has maintained that they had seen the runway lights.

- ILS approach was performed with dual AP until 200ft RALT; the aircraft was on its Glide and LOC paths and then the commander disconnected the auto pilot and continued with the manual landing.
- As per the commander, he did the manual landing as he was not sure if he can do auto-land on a ground facility which is CAT I certified airfield in actual zero visibility.
- When the aircraft was at 75ft RALT, the Captain applied two successive back stick inputs (5.5° and 7°), whereby the pitch increased up to 5.5°.
- On the lateral axis, aircraft was aligned with runway axis, however left roll was commanded on captain stick leading left roll to increase. In the meantime, a progressive right rudder pedal input was applied.
- From 23ft RALT to touchdown and beyond, TLAs were progressively retarded and reached IDLE just after touchdown.
- At 17ft RALT, a back stick input up to 12° led the pitch to increase to almost +6.5°. The increase of pitch led to a slight decrease of the aircraft speed.
- On lateral axis, the Captain applied successive right and left sidestick inputs with predominance on the left (up to full left order), increasing the left roll (up to 10° at 7ft RALT). In the mean time the right rudder pedal input was accentuated (up to 27° right order).
- These inputs led the aircraft to deviate to the left of the runway with a drift angle of 8° just before touchdown.
- The aircraft deviated to the left of the runway centre line and touched down on soft ground (in kutchra) on the LH side of the runway. The left Main L/G was first to touch down with CG at 46m on the left of the runway axis and about 1000m after the runway threshold.
- Max recorded Vertical Acceleration was 1.39G; +5.6° of pitch; 9.5° of left roll and Max recorded Lateral Acceleration of 0.35G leftward. Aircraft continued deviating leftward and LATG increased to 0.44G leftward, indicating that the aircraft was skidding to the left. During this period the left wing impacted trees causing damage to the left wing. Aircraft left Main L/G had reached about 80m left of the runway axis (maximum deviation).

- After 2 seconds, rudder pedals were released then deflected up to 37° to right. In the meantime, LATG changed from 0.44G leftward to 0.15G rightward. Aircraft stopped skidding to the left and started to come back to the runway. The aircraft entered the runway finally coming to a halt on the LH side of runway.

3.2 PROBABLE CAUSE

The cause below has been given considering events as a combination of organizational factors and human error.

- The flight crew made an erroneous decision of diverting & continuing to an airfield with reducing visibility.
- The flight crew attempted a manual landing in below minima conditions.
- Lack of operational supervision and desired ground support to flight.
- Internal quality assurance not capturing the hazards which slipped through due complacency
- Lack of oversight of the flight operations

4.0 RECOMMENDATIONS

The recommendations concerning the operator are being made after due diligence but are generic in nature and are applicable to all other scheduled operators also. DGCA may carry out one time exercise to ensure that recommendations are implemented for all the scheduled airlines.

- **The operator/All scheduled operators**

- ✚ may clarify flight dispatch policy for multi sector flights and responsibility be clearly defined with regards to dispatch of flights.

- ✚ may ensure that proper training is provided to flight dispatchers' by an authorized person including recurrent training as per DGCA requirements for preparing and interpreting the computerized flight plan for briefing purposes.
- ✚ may ensure that proper documentation w.r.t. flight dispatch be maintained.
- ✚ may clarify the role of flight dispatch vis-à-vis operations control (such as IOCC etc.).
- ✚ should depute the experienced flight dispatchers for dispatch duties so that in case of emergency, timely (safety related) advise is given to the flight crew.
- ✚ must implement flight following for every leg of all flights and necessary resources (equipment & manpower) be clearly defined.
- ✚ must, during the period of 15th of November till 10th of February make available a senior flight crew in flight dispatch between the stipulated time (foggy weather) to extend support to the flight dispatchers. Such flight crew must be supported by Met officers etc.
- ✚ must make pro-active decision well in advance for diverting flights while arriving into fog bound airports, instead of holding over destination till minimum diversion fuel (MDF) and then diverting to the alternate, which leaves the flight crew to declare "minimum fuel" (as per ICAO) and putting undue pressure on ATCOs.
- ✚ must ensure that during the period of inclement weather flight dispatch contacts the aircraft by available means (VHF/HF/ACARS/SATCOM) & relay latest weather for destination and alternates. Operations Controller must give his/her advice regarding weather trend. However final decision remains with the Commander of the flight.
- ✚ must develop a fuel consumption monitoring system to be used in FWz (Computerized Operational Flight Planning system)/ Computerized flight planning systems (Like LIDO, NAVTECH etc) specific to the aircraft registration or use the seasonal wind flight plan using the aircraft manufacturers data to avoid any error in fuel upliftment.
- ✚ must define alternates based on the weather trend (TAFOR).

- ✚ may define two designated alternates (which have defined IAP procedure for both runways) for all flights and cater for fuel for the farthest alternate.
- ✚ must ensure that fuel policy is in-line with the DGCA requirements based on the statistical data for the last 15 days, which must include fuel for ATC delays, enroute icing, congestion at the destination airport, change of routing etc.

In addition

- ✚ Flight crew must be vigilant about the weather conditions at destination and alternate by seeking weather updates in flight from company or ATC to monitor weather trend at destinations and designated alternates.
- ✚ Flight crew before operating any flight must be provided details of watch hours, alongwith details of fire fighting etc. of all the airports in the area of operation in the pre flight briefing folders.

- **DGCA**

- ✚ may consider keeping All Weather Operations (AWO) simulator training for all weather operations separate from the normal IR/ PPC training / Checks during initial and recurrent training.
- ✚ may clarify if Monsoon simulator training is a one time exercise or needs to be carried out annually for all flight crew. Same may be included in the “Explanatory Notes of AWO CAR”.
- ✚ may consider ensuring that instrument RVR is issued below 800 meters for the purpose of take-off and landing at all airports. (Many regulators clearly define that below 800 meters visibility, all take-off minima’s are defined in RVR. Same must be clarified in DGCA CAR on “All Weather Operations”.)
- ✚ must ensure that AAI defines Low Visibility Procedures for airports wherein “Low Visibility Operations” (below 800 m visibility) takes place. AIP must carry this information.
- ✚ should include incidences of declaration of fuel emergencies as one of the “Safety Indicators” (in SSP).
- ✚ should give approval/ certification to flight dispatchers. This recommendation was given in earlier investigation report also.

- ✚ Concept of “Conversion of Meteorological Visibility (CMV) to RVR” needs to be relooked into. Safety Risk Assessment must be carried out by the DGCA (Air Safety & FSD) & AAI to ensure its applicability at Indian airports.

- **AAI/IMD**

- ✚ must provide for VHF VOLMET facilities at airports like Varanasi, Ahmedabad, Nagpur, Bangalore, Guwahati, Calicut etc.


- ✚ Designated alternate (Destination and en-route) weather as mentioned in CAR Section 8, Series C, Part 1 (Table 9) must be for 01 hour before and 01 hour after the expected time of arrival at the alternate based on appropriate weather reports (METAR) or weather forecasts (TAF), or a combination of these, which indicate that, at the estimated time of arrival at the alternate airport, the ceiling and visibility at that airport will be at or above Table 9 of CAR Section 8, Series C, Part 1 (All Weather Operations) for dispatch purpose. In-flight the normal landing minima will be applicable. Same must be clarified in the “Explanatory Notes” of the said CAR.

- ✚ AAI must ensure that the watch hours of airfields around designated alternates (between 15th of November till 10th of February) are defined/ made available as NOTAM's and the airfield kept open till the last arrival of aircraft at the destination. Especially in the northern & eastern sector airfields like Amritsar, Jaipur, Udaipur, Varanasi, Lucknow, Bhubaneswar, Agartala etc.


- ✚ Delhi and all major airports must maintain updated/ latest alternate weather information which can be made available to the flight crew on request especially whenever the weather deteriorates e.g. during thunderstorm, while experiencing strong surface winds or fog.


- ✚ AAI, based on the updated statistical data must define the congestion period for all major airports in India and the information must be a part of AIP. Same can also be made available on their website.

- ✚ Met offices at airports should have all the equipment's calibrated as and when required. In case the equipment's are not calibrated NOTAM action must be taken and flight crew to be informed as equipment to be considered as unserviceable.
- ✚ IMD must ensure that accuracy of the TAF needs to be improved to help planning of alternates in an efficient manner.
- ✚ Instrument RVR facility must be made available at all airfields where CAT I ILS is established or airport is to be used for operations(Example: Take-off) below 800 meters of visibility.
- ✚ At airports wherein no low visibility procedure's has been defined by the AAI, take-off minima must be restricted to visibility of 800 meters.
- ✚ AAI must have a system to ensure that not all flights during period of congestion end up filing the same airport as an alternate. Alternates must be filed keeping the flight crew qualification & aircraft technical status in mind.
- ✚ During winter months, (approx. starting from 15th of November till 10th of February), designated destination alternates must have trend visibility that of equivalent to lowest of the Non Precision Approach (not of precision approach) for 1 hour before and after the expected time of arrival at the alternate.


 (R.S. Passi)
 Chairman
 Committee of Inquiry

12/8/16


 (N.S. Dagar)
 Member
 Committee of Inquiry


 (Dhruv Rebbapragada)
 Member
 Committee of Inquiry

DATE 12/08/2016
 PLACE NEW DELHI