GOVERNMENT OF INDIA

FINAL REPORT ON ACCIDENT TO M/S SPICE JET LTD.Q-400 AIRCRAFT VT-SUA AT HUBLI ON 08/03/2015

AIRCRAFT ACCIDENT INVESTIGATION BUREAU
MINISTRY OF CIVIL AVIATION
NEW DELHI

FOREWORD

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts examination of various components. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 11 of 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/incidents.

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FINAL REPORT ON ACCIDENT TO M/S SPICE JET LTD. BOMBARDIER Q-400 AIRCRAFT VT-SUA AT HUBLI ON 08/03/2015

1. Aircraft
   - Type : Q-400
   - Nationality : INDIAN
   - Registration : VT - SUA
2. Owner/ Operator : Maple Leaf Financing Ltd / Spice Jet Ltd.
3. Pilot – in –Command : ATPL holder on type
   Extent of injuries : Nil
4. First Officer : CPL Holder qualified on type
   Extent of injuries : Nil
5. Place of Accident : Hubli Airport ($15^0$21'36"N, $75^0$05'10"E)
6. Date & Time of Accident : 08th March 2015 & 13:45 UTC (Approx.)
7. Last point of Departure : Bangalore
8. Point of intended landing : Hubli
9. Type of operation : Schedule Operation
9. Crew on Board : 4
   Extent of injuries : Nil
10. Passengers on Board : 78
    Extent of injuries : Nil
11. Phase of operation : Landing
12. Type of accident : Runway excursion

(ALL TIMINGS IN THE REPORT ARE IN UTC)

SUMMARY:

On 08.03.2015 M/s Spice Jet Ltd. Bombardier Q-400 aircraft VT-SUA, aircraft was operating a scheduled flight from Bangalore to Hubli.

The aircraft took off from Bangalore at around 1300 UTC and weather reported for Hubli was within the crew operating minima. When the aircraft came in contact with Mangalore ATC, Mangalore ATC cleared aircraft direct to Hubli and informed heavy rains and thunder showers over Hubli with visibility 3000 m. While approaching into Hubli the pilot requested latest weather from ATC Hubli. At around 60 nm from Hubli, the weather reported by ATC Hubli was heavy rain and visibility 4000 meters. About 25 nm short of Hubli, ATC again advised visibility has reduced to 3000 m. Thereafter the crew decided to hold over Hubli until the weather improves. Twenty minutes into holding, the ATC again informed that visibility has improved to 4000m in moderate rain. Subsequently descent was requested by the PIC for runway 26. The ATC cleared VT-SUA for NDB approach runway 26, however the PIC preferred to carry out VOR DME trial procedure for runway 26.

The aircraft landed at Hubli at around 1345 UTC, during the landing roll veered toward the left side of the runway and overrun the runway edge light followed by left landing gear collapsed. Thereafter the aircraft exited the runway to its left side on Kutcha and came to the final stop at round 52 meters away from the runway center line. There was no fire. All the passengers were safely evacuated from the RH side and there was no injury to any of the occupants on board the aircraft.

The Ministry of Civil Aviation constituted a committee of inquiry to investigate into the cause of the accident under Rule 11 (1) of Aircraft (Investigation of Accidents and Accidents), Rules 2012 comprising of Sh. A X Joseph, Deputy Director, Chairman, Capt. Nitin Anand as members and Ms. Shilpy Satiya, Air Safety Officer as member secretary vide order No. AV.15018/80/2015.

1. FACTUAL INFORMATION.

1.1 History of the flight

On 08.03.2015 M/s Spice Jet Ltd. Bombardier Q-400 aircraft VT-SUA, was operating a scheduled flight from Bangalore to Hubli under the command of ATPL license holder endorsed on type with duly qualified First Officer on type. There were 78 passengers and 4 crew members on board the aircraft.

Previous to the accident flight, the aircraft VT-SUA had operated a flight Chennai – Bangalore with the same PIC. The flight was uneventful and there was no snag reported by the PIC on the completion of the flight. Subsequently the aircraft was scheduled for SG-1085, Bangalore - Hubli on 08.03.2015 at around 13:00 UTC.

The aircraft took off from Bangalore at around 1300 UTC and the visibility reported for Hubli was 10 km. When the aircraft came in contact with Mangalore ATC, Mangalore ATC cleared aircraft direct to Hubli and informed heavy rains and thunder showers over Hubli with visibility 3000 m. Since the weather at Hubli had deteriorated, the PIC reduced aircraft speed for reassuring the flight parameters. As there is no refueling facility available at Hubli, the sector is a tankering sector hence the aircraft had enough fuel for holding. While approaching into Hubli the pilot requested latest weather from ATC Hubli. At around 60 nm from Hubli, the weather reported by ATC Hubli was heavy rain and visibility 4000 meters. The ATC cleared aircraft for NDB approach runway 26, however the PIC preferred to carry out VOR DME trial procedure for runway 26.

The runway condition was neither asked by the cockpit crew nor intimated by the ATC. The descent was commenced and about 25 nm short of Hubli, ATC again advised visibility has reduced to 3000 m due heavy rain and thunderstorm. Thereafter the crew decided to hold over Hubli until the weather improves. 20 minutes into holding, the ATC again informed that visibility has improved to 4000m in moderate rain.

Subsequently descent was requested by the pilot for runway 26. The PIC stated that he had established visual reference with runway at about 6 nm on the final approach course. The crew also selected vipers on short finals to have a better visibility. The aircraft landed normally.

The PIC had stated that after touch down and reducing power to DISC, as he was concentrating on the far end of the runway as the runway was wet, he did not realize that the aircraft was drifting to the left of the center line. He further mentioned that he selected full reverse on both the engines to maintain the aircraft on the center line however the aircraft veered toward the left side of the runway and in the process overrun the runway edge light followed by LH landing gear collapsed. After the left landing gear collapsed the left propeller blades hit the runway surface and sheared off from the root attachment. The PIC maneuvered the aircraft however the nose wheel tyre failed under over load conditions and the nose landing gear collapsed and the aircraft belly came in contact with the runway surface. Subsequently, the aircraft exited the runway on the left side on Kutcha and came to the final stop at round 52 meters away from the runway center line.

The cockpit crew switched off the engines and the electrical power supply and cockpit door and announced evacuation. The cabin crew opened and the cabin doors on the right for evacuation. The ATC had alerted the fire services and the fire vehicles reached the aircraft after it came to final halt position. The fire personnel also assisted in the safe evacuation of all the passengers from the RH side. There was no injury to any of the occupants on board the aircraft. There was no post-accident fire.

1.2 Injuries to persons.

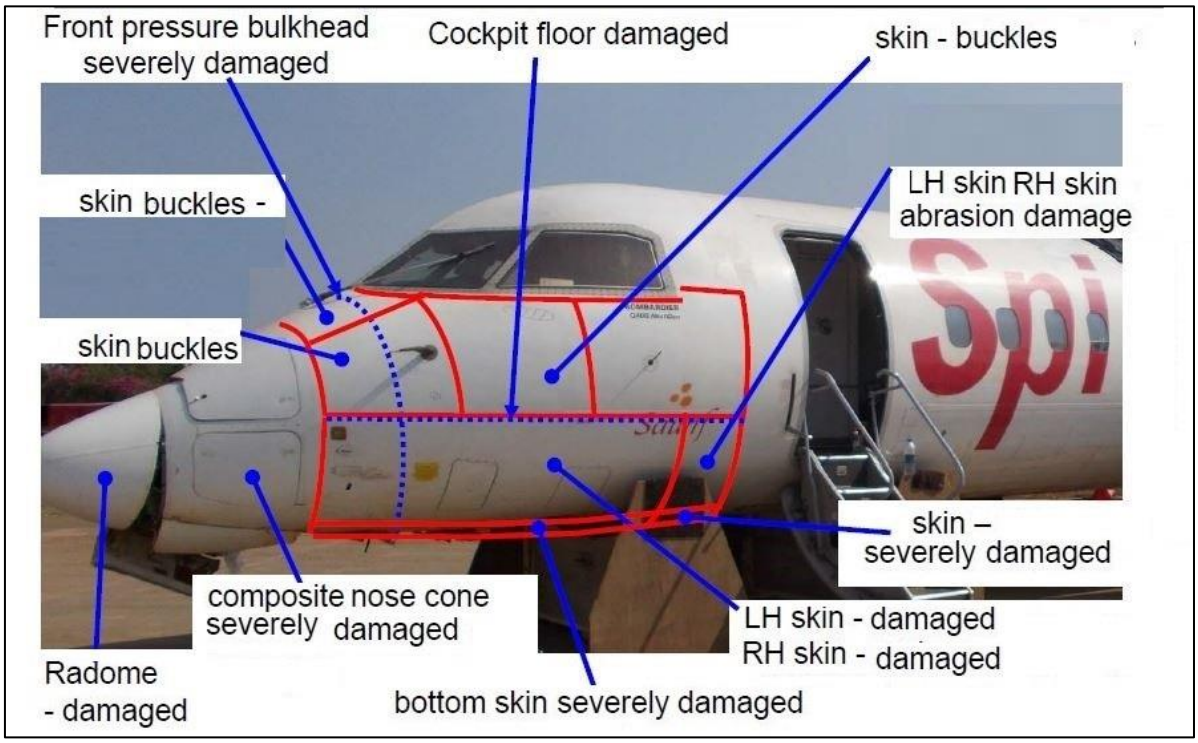
INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
MINOR/None	04	78	----

1.3 Damage to aircraft.

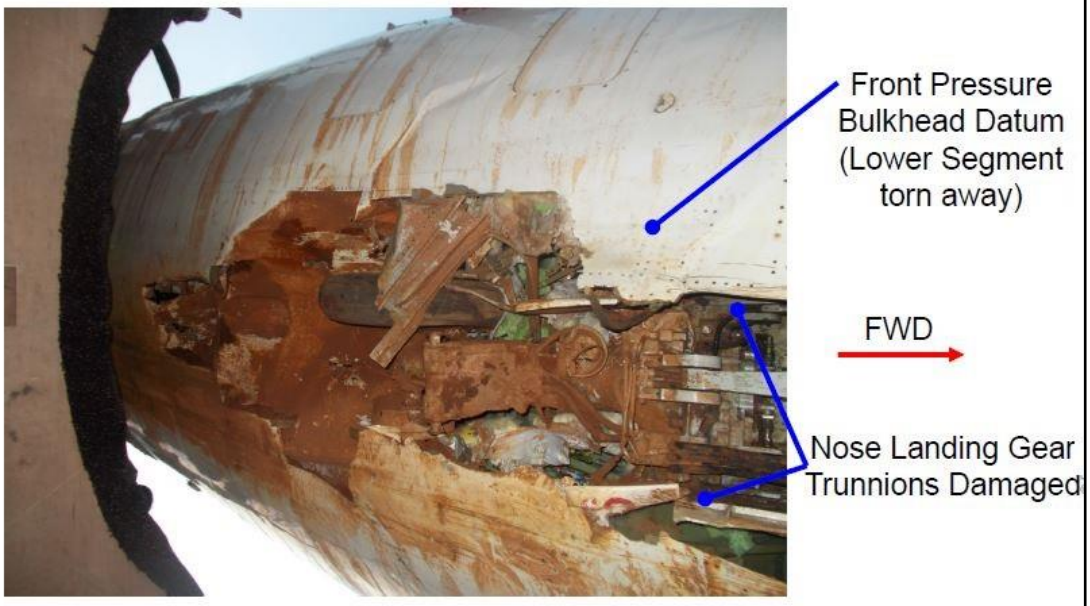
The aircraft sustained substantial damage. The damages observed are as follows.

FUSELAGE:

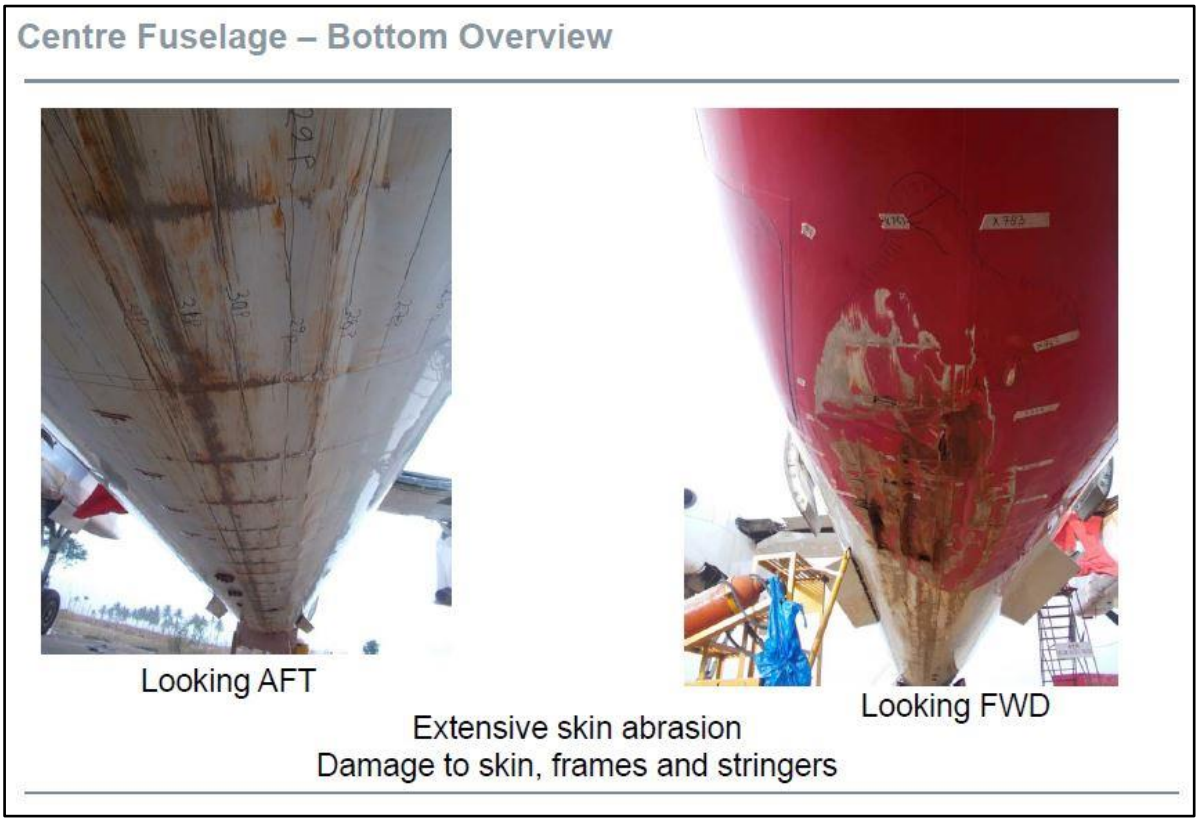
- Nose landing gear collapsed, skin and forward pressure bulkhead ruptured.
- Nose Radome & the composite structure behind Radome was cracked and damaged.
- The access panels of the FWD Equipment compartments were deformed.
- FWD pressure bulkhead lower section was cracked and bent towards aft.
- On LH side above aft PAX door structure, sharp FOD penetration damage was observed.
- LH side lateral strake damaged.
- Skin cracks on multiple (three) locations on RH fuselage due to stone penetration
- Fuselage skin adjacent of the RH propeller had stone damages
- Belly area has been inspected by opening the floor board of cabin aisle. Found skin damage & rivets are pulled out from many places from station no. X-701 to X- 111.00 (fwd).
- Warping observed on all frames , stringers and stiffeners
- Skin Warping Fwd crown fuselage structure above window no.4 (station no. X -176 to x- 216 and approximately between stringer no. 1 to 9).



Front Fuselage – Lower Structure Overview



View Looking Up on the Bottom Front Fuselage



WING

- LH Wing OUTBD end damaged, all Left Wing Static Dischargers damaged and warping on all fuel tank access panels
- LH aileron damaged.
- LH inboard flap damaged
- LH flap track OUTBD fairings damaged, Dent on LHS Wing INBD Flap bottom section.

LH ENGINE

- LH nacelle structure damaged
- LH engine LPC case cracked & separated from inlet case shroud.
- LH engine turbine damaged, small blade segment found behind the engine exhaust area.
- LH engine exhaust shroud separated from nozzle.
- LH engine inlet deicer boot damaged.
- LH side all six propeller blades completely damaged

RH ENGINE

- Visual inspection carried out. Found No visible damage on Compressor Inlet + Turbine + Exhaust Pipe. Rotating parts are free to rotate. Mud found on bypass area. MCD inspection of AGB+RGB+AC GEN carried out and found NO Chip or Fudge
- RH side all the six propeller blades are damaged.

MAIN GEAR

- LH side landing gear collapsed, towards designed direction of retraction. It was partially into the left main landing gear bay.
- LH landing gear doors damaged.
- RH side landing gears appears to be off centered.

NOSE GEAR

- LH nose wheel tyre damaged. LH nose wheel hub damaged.
- Nose landing gear doors damaged. The LH of bottom fuselage adjacent to LH NLG damaged
- Nose gear collapsed.
- LH nose wheel dislodged from wheel hub. Hub also damaged

1.4 **Other damage:** 01 runway light was broken and aircraft belly skid marks were observed on the runway.

LH Gear Point of Impact with the runway lights

1.5 Personnel information:

1.5.1 Pilot – in – Command:

AGE	: 46 years
Licence	: ATPL Holder
Date of Initial Issue	: 05/08/2011
Date of Re-issue	: 05/08/2013
Valid up to	: 04/08/2015
Category	: Aeroplane
Class	: Multi Engine Land
Endorsements as PIC	: Bombardier Q-400
Date of Med. Exam.	: 22/10/2014
Med. Exam valid upto	: 21/04/2015
FRTO Licence No.	: Valid
Date of issue	: 30/10/2014
Total flying experience	: 7050 hours
Experience on type	: 1850 hours
Experience as PIC on type	: 1700 hours

Total flying experience during last 180 days	: 366:05 hours
Total flying experience during last 90 days	: 177:03 hours
Total flying experience during last 30 days	: 59:03hours
Total flying experience during last 07 Days	: 05:03 hours
Total flying experience during last 24 Hours	: 01:05 hours

1.5.2 Co-Pilot:

AGE	: 24 years
License	: CPL Holder
Date of Issue	: 19/11/2010
Valid up to	: 18/11/2015
Category	: Aeroplane

Class	:	Multi Engine Land
Endorsements as PIC	:	Cessna 152 A, P-68 C
Endorsements as Co-Pilot	:	Bombardier Q-400
Date of Med. Exam.	:	16/06/2014
Med. Exam valid upto	:	15/06/2015
FRTO	:	Valid
Total flying experience	:	1343.17 hours
Experience on type	:	1083.47 hours
Last flown on type	:	07/03/2015

Total flying experience during last 180 days	:	345:23 hours
Total flying experience during last 90 days	:	189:01hours
Total flying experience during last 30 days	:	51:54 hours
Total flying experience during last 07 Days	:	14:20 hours
Total flying experience during last 24 Hours	:	06:55 hours

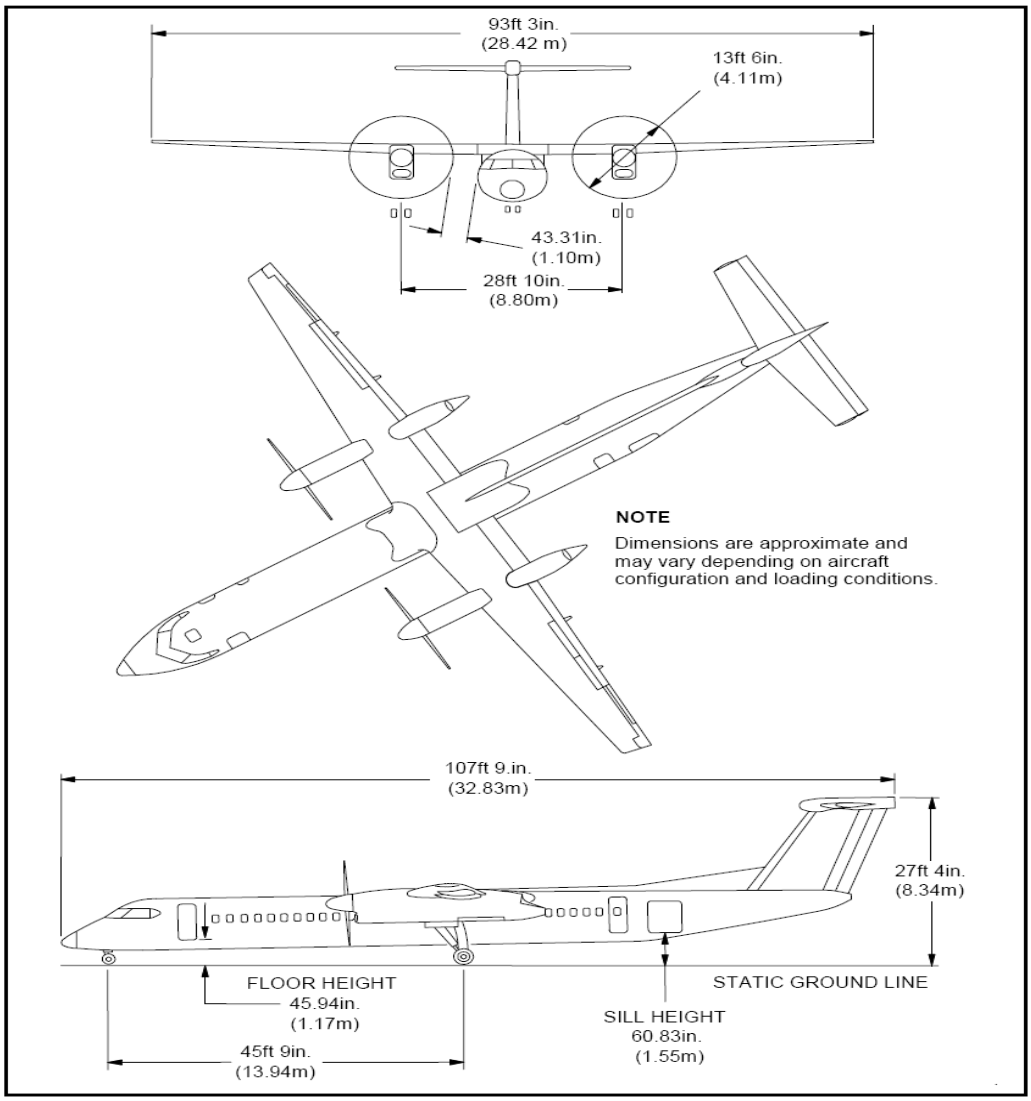
Both the operating crew were not involved in any serious incident/ accident in the past. The licenses of both the cockpit crew and all the training were current and valid. Both the crew had adequate rest prior to roster for the accident flight.

1.6 Aircraft information:

The aircraft is a metal high winged monoplane with fully cantilever wings and horizontal stabilizer surfaces, a semi–monocoque fuselage and a fully retractable tricycle landing gear. A large portion of the skin panels are bonded assemblies consisting of a skin, stringers and doublers, or skin sandwich with a honeycomb core.

The two nacelles, one on each side of the fuselage, mounted below the wing, house the power plants, accommodate the landing gears and some additional equipment. The nacelle comprises the following three main areas of structure i.e. Forward, Centre and Aft. The center nacelle structure which is located between nacelle stations 121.230 and 210.000 houses the A–Frame which attaches to MLG

drag–strut and side–braces. The A–Frame is machined from a solid aluminum alloy billet.



LANDING GEAR CONSTRUCTION

The landing gear is electrically controlled and hydraulically operated. The tricycle gear is a retractable dual wheel installation. The main gears retract aft into the nacelles and the nose gear retracts forward into the nose section. Doors completely enclose the landing gear when it is retracted and partially enclose the gear when it is down.

Main Landing Gear: The Main Landing Gear includes the components that follow:

- Yoke
- Shock Strut

– Stabilizer Brace
– Drag Strut
– Uplock Assembly
– Downlock Release Actuator
– Retraction Actuator
– Auxiliary Extension Actuator

Each MLG assembly is installed on the airframe structure in the wheel well of the related engine nacelle. Each MLG has two wheel and tire assemblies and retracts rearwards into the aft section of the wheel well.

A retraction actuator is attached to the yoke and to the shock strut to extend and retract the MLG. A lock actuator on the stabilizer brace locks the MLG in the down position. An auxiliary extension actuator is attached to the airframe structure in the aft section of the wheel well and to the arm of the yoke. The auxiliary extension actuator extends the MLG during an alternate extension sequence. An uplock assembly is attached to the top of the aft section of the wheel well and locks the MLG in the retracted position.

The yoke is attached to the top of the aft section of the wheelwell. The shock strut is attached to the bottom of the yoke. A stabilizer brace keeps the yoke in position in the wheelwell. The stabilizer brace is attached to the front of the yoke and to the forward frame of the forward section of the wheelwell. The shock strut is held in position, in the wheelwell, by the drag strut. The drag strut is attached to the bottom of the shock strut cylinder and to the forward frame of the forward section of the wheelwell. The shock strut has provision for the wheels, brake units, and anti-skid devices to attach to the axles.

Landing gear system description and operation:

The landing gear selector lever and the proximity sensor electronic unit (PSEU) control the operation of the landing gear. The number 2 hydraulic system

supplies the power to the landing gear. Hydraulic retraction or extension starts when the landing gear selector lever is moved to the desired position. The PSEU checks the status of the MLG and the MLG doors, and compares it with the command selected. The PSEU verifies the "down and locked" status of the gear through signals sent to it by 2 proximity sensors on each main gear, as well as an uplock sensor and a door sensor. When these sensors and targets are close together (read by the PSEU as "NEAR"11), this indicates that the gear is down and in a locked condition. When the gear is not locked down or is in transition, the proximity sensors are read by the PSEU as being in a "FAR"12 condition. The PSEU also controls the hydraulic sequences to either fully extend or fully retract the landing gear. The status of the landing gear and the landing gear doors is shown in the cockpit by the indicator lights on the landing gear control panel. A "landing gear inoperative" (LDG GEAR INOP) caution light on the Caution and Warning panel indicates a fault in the landing gear retraction and extension system.

• The landing gear starts to extend when the landing gear selector lever is unlocked and moved to the down (DN) position.

• The down solenoid of the selector valve receives electrical power.

• The selector valve supplies aircraft hydraulic system pressure and flow into the extend side of the landing gear hydraulic system.

Main landing gear extension

When the landing gear selector lever is moved to the down position, the 2 MLG solenoid sequence valves (SSVs) remain de-energized. At the start of the normal MLG extend sequence, these de-energized SSVs supply hydraulic pressure to the retract side of the MLG aft doors actuators, opening the MLG aft doors. When the MLG aft doors are approximately 93% open, the MLG aft doors linkage operates the mechanical sequence valve. The valve supplies hydraulic pressure to the uplock release actuators and to the down side of the MLG retraction actuators. The MLG then starts to travel to the down and locked position.

Three proximity sensors are used to monitor the MLG extension sequence. Each MLG has 2 down-and-locked sensors and 1 MLG aft-doors-closed sensor.

When the PSEU receives input signals that the MLG is down and locked, the PSEU energizes the SSVs.

Pressure is then supplied to the MLG aft doors actuators to close the MLG aft doors. At approximately 7% reverse travel of the MLG doors, the mechanical sequence valves close. This action isolates the MLG retraction actuator from the rest of the hydraulic system. In-line restrictors keep the down side of MLG retraction actuators pressurized to 3000 pounds per square inch (psi) at the end of the extension sequence.

When the landing gear is down and locked, the SSVs and the down solenoid of the selector valve are kept in an energized condition. This condition maintains hydraulic pressure on the down side of the retraction actuators and the down side of the MLG unlock actuators, which helps keep the over-centre lock links in a position that locks the stabilizer brace.

Landing gear control Panel :

The landing gear is controlled and monitored from the landing gear control panel, located on the right side of the engine display on the forward instrument panel in the flight deck. The panel has a landing gear selector lever, a lock-release selector lever, landing gear and landing gear door advisory lights, and a landing gear warning horn/mute test switch. The landing gear is commanded to the up or down position with the landing gear selector lever. An amber light in the landing gear selector lever is illuminated when the landing gear position does not agree with the landing gear selector handle position or when any of the landing gear doors are not closed.

Landing gear selector valve:

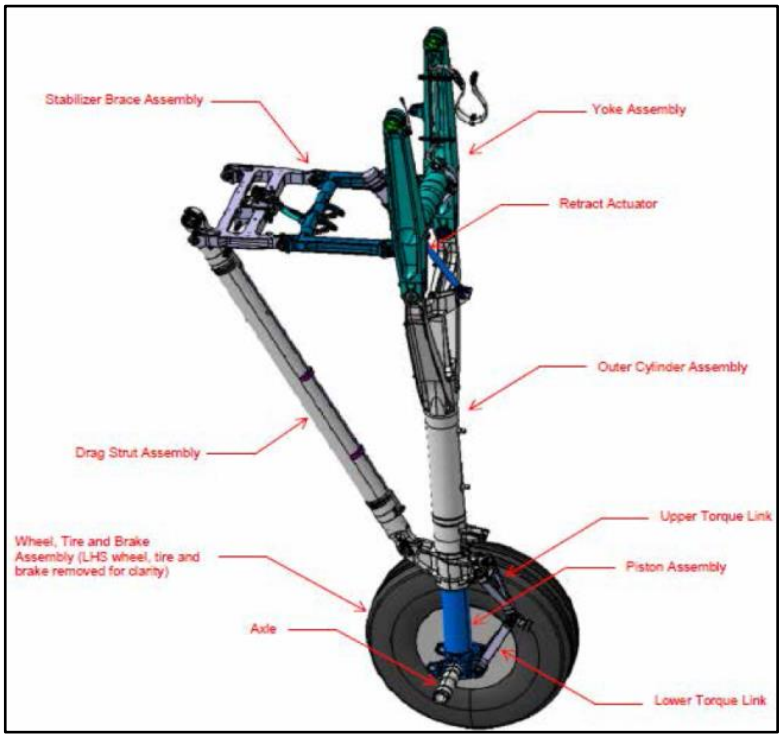
The landing gear selector valve is a self-contained assembly with 2 solenoid valves. It controls hydraulic pressure to position a directional control valve that is spring-centred. The position of the valve controls the supply of hydraulic pressure

to either the up or down hydraulic circuits of the landing gear system. The landing gear system can be configured for either normal retraction or extension.

Main landing gear unlock actuator

The MLG unlock actuator has 2 ports, to which hydraulic lines are attached and sealed with O-rings. The MLG unlock actuator is attached to the MLG stabilizer brace assembly. The unlock actuator's primary function is to unlock the stabilizer brace. When the MLG is down and locked, this actuator also provides down-force, helping the lock links to stay in an over-centre position.

The retraction actuator is designed to move the landing gear up when the aircraft get airborne.



Aircraft VT-SUA (MSN 4373) was manufactured in year 2011 and was registered with DGCA under the ownership of M/S Maple Leaf Financing Limited. The aircraft is registered under Category 'A' and the Certificate of registration No. 4241.

The Certificate of Airworthiness Number 6350 under "Normal category" subdivision Passenger / Mail / Goods was issued by DGCA on 25.08.2011. The specified minimum operating crew is two and the maximum all up weight is 29257 Kgs. At the time of accident the Certificate of Airworthiness was current with unlimited validity.

The Aircraft was holding a valid Aero Mobile License No. A-010/033-RLO(NR) at the time of accident. This Aircraft was operated under Scheduled Operator's Permit No S-16 which was valid up to 16.05.2018. As on 09.03.2015 the aircraft had logged 10224:03 Airframe Hours and 9440 cycles.

The Bombardier DHC-8-402 aircraft and its Engines are being maintained as per the maintenance program consisting of calendar period/ flying Hours or Cycles based maintenance as per maintenance program approved by Regional Airworthiness office, Delhi.

Accordingly, the last major inspection Base check-1 (6000 FH check) carried out at 5377 cycles on 08.10.2013. Subsequently all lower inspections (Preflight checks, 50 FH Inspections) were carried out as and when due before the accident.

The aircraft was last weighed on 11.06.2011 at Bombardier Inc. Toronto, Canada and the weight schedule was prepared and duly approved by the office of Deputy Director General, DGCA, Delhi. As per the approved weight schedule the Empty weight of the aircraft is 17530.59 Kgs. Maximum Usable fuel Quantity is 5318 Kgs. Maximum payload with fuel tanks full is 5803.31 Kgs. Empty weight CG is 10.01 meters aft of datum. As there has not been any major modification affecting weight & balance since last weighing, hence the next weighing is due on 10.06.2016. Prior to the accident flight the weight and balance of the aircraft was well within the operating limits.

All the concerned Airworthiness Directive, mandatory Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine has been complied with as on date of event.

Transit Inspections are carried out as per approved Transit Inspection schedules and all the higher inspection schedules include checks 1 inspection as per the manufacturer's guidelines as specified in Maintenance Program and are approved by the Continuing Airworthiness Manager (Post Holder for Continuous Airworthiness).

The last fuel microbiological test was done through Fuelstat test kit on 06.07.2014 at Hyderabad by SpiceJet Certifying staff and the microbiological growth was negligible.

The left Engine S/N PCE-FA0874 had logged 5631:56 Hrs and 5273 cycles and the right Engine S/N FA0790 had logged 6460:11 Hrs and 5975 cycles. There was no defect report on the engine on the previous flight.

1.7 Meteorological information:

The following is the Met report of Hubli on the date of accident between 1200 hrs to 1400hrs

Time (UTC)	Wind Dir	Wind Speed (kts)	Visibility (meter)	Weather	QHN
1200	250	09	6000	TSRA	1015.2
1230	170	13	6000	TSRA	1016.4
1245 speci	230	11	3000	TSRA	1016.4
1300	230	13	4000	TSRA	1017.5
1315 speci	220	11	3000	TSRA	1018.4
1330	200	06	4000	TSRA	1018.6
1400	180	05	4000	TSRA	1018.7

1.8 Aids to navigation:

There is one single runway available at Hubli which has the orientation 08/26. For landing runway 08/26 VORDME approach is available. PAPI is available for both sides of the runway. NDB is also available at Hubli for approach and landing. The ATC is controlled and manned by Airports Authority of India.

1.9 Communications: There was always two way communication between the ATC and the aircraft.

1.10 Aerodrome information:

Hubli airfield and ATC are controlled by Airports Authority of India. The ATC watch hours are from 1230 to 1600 UTC. It has one single runway with orientation 08/26 and is 1674 meter in length. The aerodrome elevation is about 2169 feet. The airfield is equipped to provide VOR/DME approach on either side of the runway. The PAPI and NDB is also available for the runway 08/26. The aerodrome was licensed on 12.08.2011 and was valid at the time of accident. At the time of accident the runway width extension was in progress.

DGCA CAR Section 4, Series B part I states that "In case of construction, such as runway or taxiways, where the surface must also be flush with the strip surface, a vertical face can be eliminated by chamfering from the top of the construction to not less than 30 cm below the strip surface level. Other objects, the functions of which do not require them to be at surface level, should be buried to a depth of not less than 30 cm."

1.11 **Flight recorders**: The Cockpit Voice Recorder (CVR) and the Digital Flight Data Recorder (DFDR) was downloaded and the following information was available from them

CVR:

1. Mangalore ATC cleared the aircraft direct to Hubli.
2. While approaching into Hubli the Commander of the aircraft requested the weather updates from ATC Hubli.

3. Initially the weather reported by ATC Hubli was heavy rain and visibility 4000 meters.
4. The Commander informed the ATC that they are holding at radial 150 between 10DME to 20 DME HBL for weather to clear up and will continue to wait for further five minutes.
5. The Commander inquired with the First Officer about the availability of the fuel onboard for which the First Officer replied that the fuel is sufficient.
6. The commander informed ATC Hubli they are not able to contact Mangalore ATC and requested Hubli ATC to Inform Mangalore ATC about their holding at FL100.
7. The commander informed ATC Hubli that after the completion of second hold they will attempt one approach and requested for latest weather.
8. The weather reported by ATC was moderate rain and visibility 4000 meters.
9. Subsequently the ATC cleared the aircraft for NDB approach and landing runway 26.
10. The first officer informed PIC that ATC had cleared them for NDB approach however the PIC advised the first officer that they will proceed to carry out VOR DME approach and landing.
11. During final approach the winds were reported as 200/04 kts by ATC.
12. After touch down the first officer gave a call out "Watch Watch".

DFDR:

Following findings were made from the DFDR analysis.

- The Aircraft VT-SUA had engaged the VOR at 4078 ft for 1min 32 sec during Outbound of radial/bearing. Further during Procedural turn again VOR was engaged from 4048 ft to 3754 ft inbound track. After 3754 ft till touchdown Aircraft carried visual approach.
- The aircraft was stabilized at 500 ft with following parameters
    - Speed 127 Kts, Power 23% both engine, Vertical speed -510 fpm, pitch down 2 Deg, Roll attitude 1.4 Deg left, Flap 35 Deg.

Note: - From 50 ft to 3ft, changes in rolls attitude is observed which is mentioned below:

Time (UTC)	Height	Roll attitude (Deg)	Power	Heading	Power Lever (Left)
13:44	50 ft		30% both	264 deg	49 Deg
13:44:37	35 ft	Right 1.1, Right 2			
13:44:38	20ft	Left 1.5, Left 2.8			
13:44:39	13ft	Right 0.5, Right 1.5			
13:44:40	8ft	Left 0.4, Left 0.9		262 Deg	
13:44:41	5 ft	Right 1.7, Right 0.5			
13:44:42	3ft	Left 0.4, Right 0.7		263 Deg	

- **At 13:44:42 (UTC)** Aircraft was at 3 ft:
  - Speed was 124 Kts
  - Aircraft Heading 263 Deg
  - Pitch was down 0.6Deg
  - Power lever Left 35 Deg with torque 11 %
  - Power lever Right 35 deg with torque 8 %
  - Rudder pedal position was 0.3 right and rudder position was 1.1 Deg right.
  - Right Aileron position changed to 6 Deg up from 0.1 up.
  - Aircraft roll to 0.4Deg left from 1.7 Deg right.

- **At 13:44:43 (UTC)**:
  - Aircraft main wheel touched
  - Vertical acceleration 1.18 G
  - Aircraft Heading 264 Deg
  - Speed was 124 Kts
  - Pitch was down 0.5Deg
  - Power lever Left 26 Deg with torque 3 %
  - Power lever Right 11 deg with torque 4 %

- Aircraft roll attitude 0.8 Deg left
- Right Aileron position up 3.3 Deg.
- Rudder pedal and rudder position were both 0.5 Deg right.

- **At 13:44:44 (UTC):**
  - Aircraft nose wheel touched
  - Vertical acceleration 1.3 G
  - Aircraft Heading 264 Deg
  - Speed was 119 Kts
  - Power lever Left 11 Deg (Reverse) with torque -2 %
  - Power lever Right 19 deg (Disc) with torque -0.5%
  - Aircraft roll attitude 0.7 Deg left
  - Rudder pedal position was 0.6 right and rudder position was 0.2 Deg right.
  - Wind 218 Deg 02 kts

- **At 13:44:45 (UTC)** both power lever moved to 19 Deg (Disc)
  Note- Nose wheel touched after one second of main wheel and Aircraft average roll attitude after all wheel touched ground till main wheel collapse was 0.75 left.

- **At 13:44:46 (UTC)**
  - Rudder pedal position moved to 1.6 Left and rudder position moved to 3.3 Deg left.
  - Right Aileron position moved to up 4.6 Deg
  - Aircraft Heading 263 Deg

- **At 13:44: 51(UTC)**
  - Main Landing Gear collapse
  - Pitch Attitude up 1.7 Deg
  - Roll Attitude 15.3 Deg left
  - Vertical acceleration 2.05 G
  - Speed 77 Kts
  - Aircraft Heading 268

Note: - Before the main Landing Gear collapse Left power lever remained at 19 Deg (Disc) and Right Power lever was moved to 22 Deg and roll attitude changed to 3.3 Deg Left.

- **At 13:44:57 (UTC)**
  - Nose Landing Gear collapse
  - Speed 46 kts
  - Roll Attitude 14.7 Deg left

Note: - Few seconds before of Nose landing Gear collapse Brake pedal force applied both left and right.

1.12 Wreckage and impact information.

During examination of the wreckage at the crash site, it was observed that aircraft had sustained substantial damage and was resting 52 m away from the left of the centre line on its belly and on the right main landing gear.

As per the evidences collected at the crash site, the aircraft landed slightly ahead of the aiming point and left to the centre line of the runway at a distance 399 m from the threshold. After travelling for about 841 meter from the threshold the aircraft overrun the runway edge light no. 56. After the impact with the runway

light, the left main landing gear collapsed. As the gear collapsed the left propeller came in contact with the runway surface at around 902 m from the threshold and all the five propeller blades sheared off from the root attachment. The area of the propeller strike marks was about 40 feet long, with approximately 2 feet between marks broken pieces of the propeller were found on the left side of the runway.

Thereafter the PIC manoeuvred the aircraft back on the runway however the nose wheel tyre failed under over load conditions and the nose landing gear collapsed and the aircraft belly came in contact with the runway surface. The nose wheel of the aircraft was found on the runway at a distance 955 m from the threshold.

With no directional control on the aircraft the aircraft veered to the left on the soft ground and stopped at round 52 meters away from the runway centre line.

1.13 Medical and pathological Information:

Both the pilots had undergone preflight medical check prior to the first flight at Hyderabad and the same was negative.

1.14 Fire:

There was no fire after the accident.

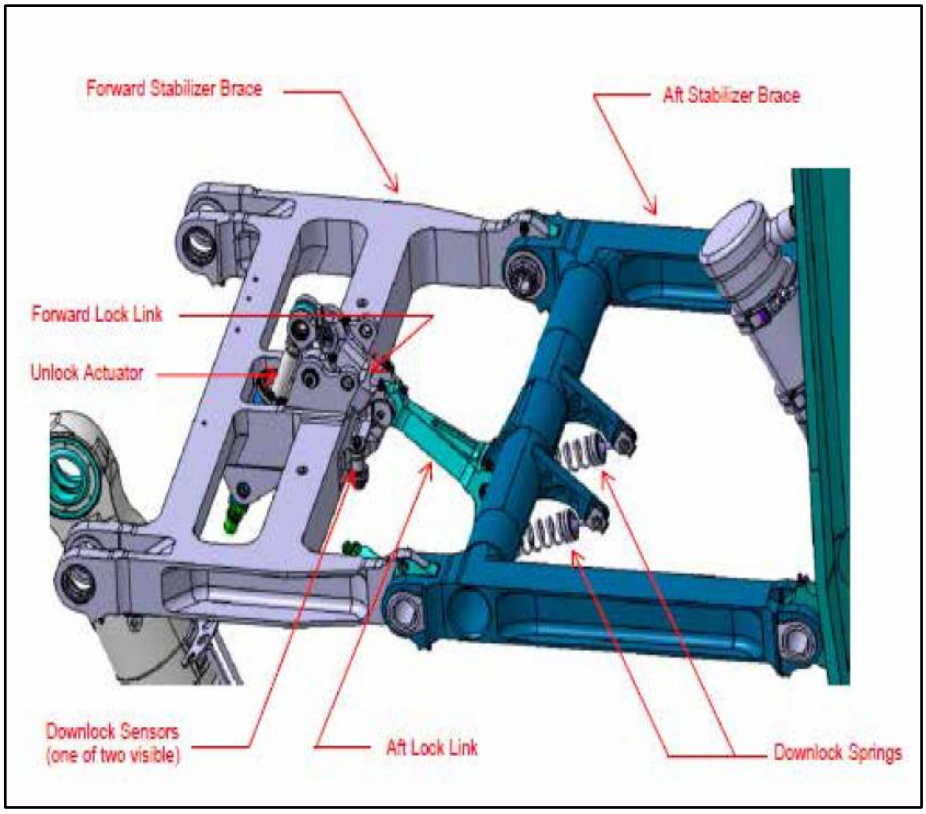
1.15 Survival aspects:

The Fire Officer in charge at Hubli airport had stated that prior to landing of VT-SUA at Hubli, as a normal procedure all the crew were ready in the fire vehicles. The aircraft landed and after few seconds a huge sound was heard and immediately the fire bell and the crash alarm was also raised from the ATC tower. All the vehicles reached the crash site immediately and saw the aircraft had skidded off the runway on the left side and was resting on its belly. There was no smoke or fire from the aircraft. Two of the fire crew went into front and found the starboard door in open position and other two went to the rear and they helped all the passengers to evacuate from the aircraft. There was no causality or injury to any of the passenger during evacuation. The passengers were immediately shifted to the terminal building. One crash fire tender was positioned at the aircraft in case there is an inadvertent fire after the accident. The accident was survivable.

1.16 Tests and research:

After the accident, the collapsed left landing gear assembly and the gear retraction/extension assembly was removed from the aircraft and sent to Transport Safety Board Canada in April 2015 for further investigation at the manufacturer

facility. Safety Board of Canada had sent a report in August 2016 for the accident of Jazz Aviation Q-400 aircraft and intimated that the accident to VT-SUA at Hubli was similar in nature. No separate investigation report for VT-SUA was provide by Transport Safety Board Canada to the AAIB.



The report reflected that the landing gears and all involved systems were inspected and their function checked. Both shock struts were found to be correctly serviced, and all grease points were adequately lubricated. No components had visible damage, except for the failed retraction actuator that retracts and extends the landing gear. It had failed under a compression load due to the weight of the aircraft when the gear came unlocked. The gear came unlock probably when the aircraft hit the runway edge light. The retraction actuator is not designed to hold the gear extended, but only to move it when airborne.

1.17 Organizational and management information:

M/s Spice jet Ltd. is a scheduled airline with a fleet of 29 Boeing 737-800 and 06 B737-900 (ER) aircraft and 17 Bombardier Q-400 aircraft operating flights

on domestic and international sectors. The Airlines Head Quarter is located at New Delhi. The Air operator permit of the Airlines is valid till 30/06/2018. The Company is headed by Chief Executive Officer assisted by a team of professional of various departments. The Flight Safety Department is headed by Chief of Flight Safety approved by DGCA. The Chief of Safety is senior management official who reports directly to the CEO.

M/s Spice jet has a full established Operations training facility for the pilots. The training facility for both Boeing pilots and Bombardier Q-400 pilots is setup at Delhi. The training facilities are headed by the senior vice president Operations who reports to Chairman directly. The Engineering training facility is established at Delhi for B737 aircraft and Hyderabad for Q-400 aircrafts.

1.18 Additional information:

1.18.1 DGCA Office Memorandum AV.15026/006/92-AS Dated 3rd Feb 1992

DGCA has issued an Office Memorandum (OM) regarding the guidelines for preparing instrument Approach and landing (IAL) procedure. As per the OM, the draft IAL procedure will be given at least three flight trials by examiners or instructor of the operator. The flight inspectors of the DGCA may also check the procedure either flying themselves or going as observer in the cockpit. The flight trials should be run in VMC conditions and during day time only.

1.18.2 Spice jet Operation Circular 35/2014

M/s Spice jet had issued an internal Operational Circular wherein a detailed Procedures was made for Cat-B/Non Precision Approach/CDFA Approach with Flaps 35 on Q-400 aircraft. Also as per Company policy VOR Trial shall be carried out by a Check pilot & above qualified crew only. The chief pilot training had also issued an email that line captains with more than 1000 hrs of experience as PIC may also carry out VOR trial procedures.

1.19 Useful or effective investigation techniques: NIL

2 ANALYSIS

2.1 Serviceability of the aircraft:

Aircraft VT-SUA (MSN 4373) was manufactured in year 2011. The aircraft was registered with DGCA. At the time of accident the Certificate of Airworthiness was current and validity.

This Aircraft was operated under Scheduled Operator's Permit No S-16 which was valid up to 16.05.2018. As on 09.03.2015 the aircraft had logged 10224:03 Airframe Hours and 9440 cycles. The aircraft and its Engines were being maintained as per the maintenance program approved by Regional Airworthiness office, Delhi.

The Q-400 aircraft and Engines are being maintained under continuous maintenance as per maintenance program consisting of calendar period based maintenance and Flying Hours / Cycles based maintenance as per maintenance program approved by Office of DDG, DGCA, Northern region. Accordingly the last major inspection carried out at 5377cycles on 08.10.2013. Subsequently all lower inspections, after last flight inspection and preflight checks were carried out as and when due before the accident

All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modification on this helicopter and its engine have been complied with as & when due. The defect record of the aircraft were scrutinized for a period of one month prior to the date of occurrence of the serious accident and no defect was found pending on the aircraft. Prior to the accident flight the weight and balance of the aircraft was well within the operating limits.

From the above it is inferred that the serviceability of the aircraft is not a factor to the accident.

2.2 Weather:

Prior to take off from Bangalore, the weather was fine. The aircraft took off from Bangalore at around 1300 UTC and weather reported for Hubli was within the crew operating minima. When the aircraft came in contact with Mangalore ATC, Mangalore ATC cleared aircraft direct to Hubli and informed heavy rains and thunder showers over Hubli with visibility 3000 m. While approaching into Hubli the pilot requested latest weather from ATC Hubli. At around 60 nm from Hubli, the weather reported by ATC Hubli was heavy rain and visibility 4000 meters. About 25 nm short of Hubli, ATC again advised that visibility has reduced to 3000 m. Thereafter the crew decided to hold over Hubli until the weather improves. 20 minutes into holding, the ATC again informed that visibility has improved to 4000m in moderate rain and winds 200/06 knots. Subsequently the PIC requested ATC for descent for runway 26.

ATC cleared aircraft for an NDB approach however the flight crew elected to carry out trial VORDME procedure which was in violation to DGCA existing guidelines in terms of crew qualification & flight conditions (visibility and time of day requirements)

From the foregoing, it is inferred that though the weather conditions were within the operating minima of the PIC for the NDB approach but the crew was carrying out a VORDME trial procedure suo moto which was in violation of ATC instructions and DGCA guidelines for carrying out trial procedures

2.3 Aerodrome:

A NOTAM was issued on 31.01.2015, wherein the runway shoulder extension work was in progress and the pilots were advised to exercise caution. Prior to this, the entire runway had undergone the re-carpeting. The runway edge lights were temporarily placed on the runway shoulder as the shoulder extension work was in progress.

After the accident, the involved edge light assembly was examined and it was observed that the metal portion of the assembly which is not frangible, was not buried in the ground. Metal potion was temporarily chamfered with the cement and no concrete was used. This kind of arrangement of runway edge light was not as per DGCA requirements.

As the left main wheel hit the light, the frangible portion collapsed as per the design, however the metal potion which was not concealed with the cement impacted the gear. As the speed of the aircraft at the time of impact was around 80 knots the impact was strong and it caused the main left landing gear lock mechanism to unlock and the left landing gear retracted, and eventually resulted into the accident.

	
Non-frangible Runway edge light chamfered with Cement	**Runway edge light after impact with left landing gear**

2.4 Pilot handling of the aircraft:

Previous to the accident flight, the same crew had operated the flight Chennai - Bangalore. The flight was uneventful. There was no snag reported by the PIC on the completion of the flight. Subsequently the aircraft was scheduled to operate Bangalore-Hubli at around 1300 UTC.

At the time of take off from Hubli the visibility reported for Hubli was 10 kms. However, when the aircraft came in contact with Mangalore ATC, aircraft was

cleared direct to Hubli and informed heavy rains and thunder showers over Hubli with visibility 3000m. As the weather at Hubli had deteriorated, the PIC reduced aircraft speed to reassess the situation. At around 60 Nm from Hubli, the weather reported by ATC Hubli was heavy rain and visibility 4000 meters. The PIC commenced descent, however at about 25 Nm short of Hubli, ATC again advised visibility has reduced to 3000 m due heavy rain and thunderstorm. Thereafter the crew decided to hold over Hubli for weather to improve.

Twenty minutes into holding, the ATC again informed VT-SUA, that visibility has improved to 4000m in moderate rain, wind 230/13 knots. The ATC cleared the aircraft for NDB approach runway 26. However, the PIC followed VORDME procedure CAT-B/Non Precision for runway 26 at Hubli.

AS per DGCA instructions/guidelines in the OM, trial procedure is to be carried out by examiners or instructor only. Also these procedure should be run in VMC conditions and during day time only. M/s Spice jet had issued an internal Operational Circular regarding Procedures for Cat-B/Non Precision Approach/CDFA Approach. Also as per Company policy VOR Trial shall be carried out by a Check pilot & instructor only. However M/s Spice Jet Circular did not highlighted that the trail procedure are to be carry out in VMC conditions and during day time only. The chief pilot training had also issued an email that line captains with more than 1000 hrs of experience as PIC may also carry out VOR trial procedures, however this degrading of the requirements to carry out the trial procedures was not based on any risk assessment and was in contradiction to DGCA guidelines.

The PIC requested ATC for descent for runway 26. Around 6 nm on the final approach course the crew sighted the runway and aircraft was stabilized for landing. The crew also selected vipers on short finals to have a better visibility. The aircraft landed normally within the landing zone.

The PIC had stated that after touch down and reducing power to DISC, as he was concentrating on the far end of the runway as the runway was wet and he did not realize that the aircraft was drifting to the left of the centre line. He further mentioned that he selected full reverse on both the engines to maintain the aircraft

on the center line however the aircraft veered toward the left side of the runway and in the process overrun the runway edge light followed by LH landing gear collapse.

DFDR analysis revealed that the aircraft landed at time 13:44:38 UTC. The aircraft landed slightly left of the centre line and both the power levers were staggered. The left power lever was at 26 degrees and the right was at 11 degrees and the right aileron input was 3.3 degrees. One second later the left lever had gone to reverse with only -2% for two seconds only however the right lever remained at disc.

	
Point of Touchdown	Imapct with Runway Edge Light

Though the PIC had stated that he selected full reverse on both the engines does not matches with the DFDR analysis and is incorrect. Further the PIC has mentioned that he tried to maintain the aircraft on the centerline, however DFDR analysis revealed that there was no rudder input by the PIC to control the aircraft from veering towards the left. As per the DFDR only right aileron inputs was given to steer the aircraft to the right which was ineffective to control the aircraft at that speed. The aircraft veered off the runway and the left landing gear hit the runway edge light and caused the main landing gear to collapse. Subsequently the nose gear also collapsed and the aircraft was uncontrollable and it exited the runway on the left and finally came to halt around 52 meters from the center line of the runway.

	
Aircraft Belly came in contact with R/W	Final Rest positon of the aircarft

From the above it is inferred that the PIC handling of the aircraft is a factor to the accident on following account

1. The PIC applied asymmetric reverse thrust after landing.
2. The PIC failed to maintain the directional control on the runway with the available flight controls.

2.5 Circumstances leading to the Accident :

The aircraft landed slightly left of the center line around the 500ft after marker in adverse weather conditions. After landing during the roll the PIC briefly selected reverse thrust on left engine. Further the PIC noticed that the aircraft was drifting toward the left of centerline and gave in appropriate control to correct. The first officer call out to the pilot for correction in heading was non-standard and late, the aircraft continued to veer left of the center line. As the runway edge light assembly height was slightly high coupled with high speed of the aircraft, the impact with the non frangible structure was strong which caused the left main landing gear down lock mechanism to become unlocked and the landing gear collapsed. Thereafter the left propeller came in contact with the runway and sheared off from the root attachment. Subsequently the nose gear also collapsed and the aircraft was uncontrollable and it exited the runway on the left.

As the main wheel hit the light the frangible portion collapsed as per the design, however the metal potion which was above the ground impacted the gear. As the speed of the aircraft at the time of impact was around 80 knots the impact

was strong and it caused the main landing gear to unlock and collapse. Once the left main landing gear collapsed, the propeller came in contact with the ground and got sheared off. Subsequently the nose gear also collapsed and the aircraft was uncontrollable and it exited the runway on the left and finally came to halt around 52 meters from the center line of the runway

3 CONCLUSIONS:

3.1 Findings:

a) The Certificate of Airworthiness and the Certificate of Registration of the aircraft was valid on the date of accident.
b) The certificate of flight release was valid on the day of accident.
c) Both the Pilots were appropriately qualified to operate the flight.
d) All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine were found complied with.
e) Previous to the accident flight, the same aircraft had operated a flight Chennai – Bangalore and there was no snag reported after completion of the flight.
f) The aircraft took off from Bangalore at around 1300 UTC and the visibility reported for Hubli was 10 km.
g) After came in contact with Mangalore ATC, Mangalore ATC cleared aircraft direct to Hubli and informed heavy rains and thunder showers over Hubli with visibility 3000 m.
h) At around 60 nm from Hubli, the weather reported by ATC Hubli was heavy rain and visibility 4000 meters. However the runway condition was neither asked by the cockpit crew nor intimated by the ATC.
i) The descent was commenced and about 25 nm short of Hubli, ATC again advised visibility has reduced to 3000 m due heavy rain and thunderstorm.
j) The crew decided to hold over Hubli until the weather improves. 20 minutes into holding, the ATC again informed that visibility has improved to 4000m in moderate rain.
k) The ATC cleared the aircraft for NDB approach and landing runway 26. However the PIC advised the first officer that they will proceed to carry out VOR DME approach and landing.

l) AS per DGCA instructions/guidelines in the OM, trial procedure to be carried out by examiners or instructor only. Also these procedure should be run in VMC conditions and during day time only.

m) M/s Spice jet had issued an internal Operational Circular regarding Procedures for Cat-B/Non Precision Approach/CDFA Approach. Also as per Company policy VOR Trial shall be carried out by a Check pilot & instructor only.

n) The chief pilot training had also issued an email that line captains with more than 1000 hrs of experience as PIC may also carry out VOR trial procedures, however this degrading of the requirements to carry out the trial procedures was not based on any risk assessment and was in contradiction to DGCA guidelines.

o) After touch down, aircraft veered toward the left side of the runway and in the process overrun the runway edge light followed by LH landing gear collapsed.

p) DGCA CAR Section 4, Series B part I states that "In case of construction, such as runway or taxiways, where the surface must also be flush with the strip surface, a vertical face can be eliminated by chamfering from the top of the construction to not less than 30 cm below the strip surface level. Other objects, the functions of which do not require them to be at surface level, should be buried to a depth of not less than 30 cm."

q) During examination of runway edge light, it was observed that the metal portion of the assembly which is not frangible, was not buried in the ground. Metal potion was temporarily chamfered with the cement and no concrete was used. This kind of arrangement of runway edge light was not as per DGCA requirements.

r) After the left landing gear collapsed the left propeller blades hit the runway surface and sheared off from the root attachment.

s) The nose wheel tyre failed under over load conditions and the nose landing gear collapsed and the aircraft belly came in contact with the runway surface.

t) The aircraft exited the runway on the left side on Kutcha and came to the final stop at round 52 meters away from the runway center line.

u) The cockpit crew switched off the engines and the electrical power supply and cockpit door and announced evacuation. The cabin crew opened and the cabin doors on the right for evacuation.

v) The ATC had alerted the fire services and the fire vehicles reached the aircraft after it came to final halt position.

w) There was no injury to any of the occupants on board the aircraft.

x) There was no post-accident fire.

3.2 Probable cause of the accident:

Loss of visual cues after touch down in inclemental weather conditions resulted in veering of the aircraft towards left of the centerline leading to runway excursion and accident.

Following are the contributory factors.

1. Inappropriate handling technique of the aircraft controls by the PIC to maintain the directional control of the aircraft after landing.
2. Non-standards callouts by the first officer to correct situation after landing.
3. Impact of the landing gear with the non-frangible erected runway edge light resulted in retraction of the same.
4. At the time of the accident DGCA O.M. No. AV.15026/006/92- AS dated 3rd February 1992 was in force, which dictated examiners and instructors of the operators only to carry out trial procedures in VMC and during Daytime only.

   M/s Spice jet instructions to the flight crew did not reflect the same and allowed flight crew with less experience & below VMC flight conditions to carry out trial procedures. This may have contributed to the accident.

4. SAFETY RECOMMENDATIONS

1. DGCA may advise AAI to carry out one time exercise to check and address presence of all non-frangible objects within the runway strip as per provision contained in DGCA rules and regulations.

2. Operations department of M/s Spice jet airlines to issue necessary guidelines for use of standard callouts during conduct of flight especially during marginal weather conditions.

3. DGCA to advise all operators to align their policies and guidelines in accordance with latest regulations & requirements.

(Shilpy Satiya)
Air Safety Officer
Member Secretary, Committee of Inquiry

(Capt. Nitin Anand)
Member, Committee of Inquiry

(A X Joseph)
Deputy Director
Chairman, Committee of Inquiry

Date: 02.05.2017

Place: New Delhi