No. : AV.15013/5/2008/AS

REPORT

ON ACCIDENT TO PUNJAB GOVERNMENT KING AIR C-90 AIRCRAFT VT-EHY AT VILLAGE JUGIANA NEAR SAHNEWAL AIRPORT LUDHIANA ON 29.10.08

AIR SAFETY DIRECTORATE
O/o DIRECTOR GENERAL OF CIVIL AVIATION
OPP. SAFDARJUNG AIRPORT, NEW DELHI

Contents

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AAI	:	Airports Authority of India
ATC	:	Air Traffic Control
ATCO	:	Air Traffic Control Officer
ATPL	:	Air Transport Pilot License
ATS	:	Air traffic Service
CHD	:	Chandigarh
CPL	:	Commercial Pilot License
FAA	:	Federal Aviation Administration (USA)
FATA	:	Foreign Aircrew Temporary Authorization
IBANA	:	En Route Air traffic Reporting Point
IFR	:	Instrument Flight Rules
IAL	:	Instrument Approach to Land Procedure
IMD	:	Indian Meteorological Department
OLS	:	Obstacle Limiting Surface
QNH	:	Pressure Setting to Indicate Elevation
R/W	:	Runway
SHP	:	Shaft Horse Power
SIC	:	Second in Command
SKC	:	Sky Clear
TWR	:	Air traffic Control Tower
TSO	:	Time Since Overhaul
VILD	:	Ludhiana Airport
VFR	:	Visual Flight Rules
VMC	:	Visual Meteorological Conditions

REPORT ON ACCIDENT TO PUNJAB GOVERNMENT KING AIR C-90 AIRCRAFT VT-EHY AT VILLAGE JUGIANA NEAR SAHNEWAL AIRPORT LUDHIANA ON 29.10.2008

a) Aircraft

Type and Model	:	King Air C-90
Nationality	:	Indian
Registration	:	VT-EHY
b) Owner/Operator	:	Government of Punjab
c) Date of Accident	:	29.10.2008
d) Time of Last Contact with ATC	:	11:25 IST.
e) Last Point of Departure	:	Chandigarh
f) Point of Intended Landing	:	Ludhiana
g) Geographical Location of Accident	:	At a distance of 0.75km West from site the edge of R/W 12 **Coordinates**: N 30° 51´ 13.38¨ E 075° 56´ 18¨
h) Type of Operation	:	Positioning flight (State Govt. Aircraft)
i) Phase of Operation	:	Right hand circuit R/W 12

(All timings in the report are in IST)

SYNOPSIS

On 29.10.2008 Punjab Government King Air C-90 aircraft, VT-EHY met with an accident while operating flight from Chandigarh to Ludhiana. This accident was notified to DGCA by ATC at Ludhiana and Punjab Government officials shortly after the occurrence. The accident occurred when the aircraft was in the process of making second attempt for landing at Ludhiana Airport.

The accident was investigated by Inspector of Accident under Rule 71 of Aircraft Rules, 1937. As per the obligations under ICAO Annex 13, notification was sent to USA, the country of aircraft manufacture, Canada, the country of engine manufacture and ICAO. Transport Safety Board Canada appointed an accredited representative and authorized engine manufacturer M/s P&W to associate with investigation of engines.

Low visibility conditions were prevailing at Ludhiana at the time of accident. Due to which the crew located the runway late. They were estimating their position based on GPS. Though they did spot the runway at some stage of the approach, they lost sight of it again and were unable to locate it subsequently. They carried out orbits on the right side (East Side) of R/w 12 in an effort to visually locate the runway and then followed non-standard procedure to land. Not comfortable with the approach, the crew decided to go around. Due to low visibility and that they probably did not want to loose the sight of the airfield, carried out non-standard go around. In their anxiety not to loose the sight of the field they descended in three orbits in the vicinity of the airfield on the west side of R/w 12, perhaps to land after making the short circuit from the right. However, due to smoke in the cockpit, severe disorientation, lack of qualification & experience on type of aircraft and on sighting the communication tower, the panic gripped the crew. In their anxiety, the control was lost and aircraft impacted the ground in the steep left bank.

Aircraft was destroyed in the crash due to impact and post impact fire. Both the occupant on board died due to fire and collapsing aircraft structure.

Factual Information

1.1 History of the Flight

On 29.10.08 Punjab Government King Air C-90 Aircraft VT-EHY was to operate a flight from Chandigarh to Ludhiana for picking up Instructor/Examiner on type to carry out instrument rating check of Pilot in Command. The flight plan was filed for the sectors CHG (Chandigarh)-IBANA-VILD (Ludhiana), VILD-IBANA-CHG-IBANA-VILD, VILD-IBANA-CHG and the met briefing was obtained. The aircraft uplifted 1090 ltrs. of fuel from Chandigarh and there was already 600 lbs (272.2 kg) of fuel in the aircraft (total fuel on board 1133.1 kg.). The daily inspection was carried out by the AME holding approval for the type of aircraft. During the Daily Inspection no abnormality or snag was observed.

The aircraft got airborne from Chandigarh at 11:00 hrs. It was cleared to 6000 ft on QNH 1012 HPA. At 11:10:31 hrs. the aircraft turned left for Ludhiana. At 11:15:30 hrs. it flew abeam R/w 30 towards R/W12. At 11:16 hrs. aircraft came in contact with Ludhiana ATC and informed that they were eight miles and at 7000 ft to 6000 ft and requested descent clearance. At 11:17 hrs. it commenced right hand turn on east side of R/w 12 after crossing abeam Thresh hold R/W 12 and subsequently requested for R/w in use. At 11:19 hrs, while it was in right hand turn it reported overhead this time. Thereafter at 11:22hrs. it reported 2 miles from the R/w and runway still not sited. At 11:23hrs. aircraft reported over the field and informed that it will make a circle to land on R/W 12.

The reported visibility was 1500 m., QNH 1013 HPA. The aircraft was cleared for landing on R/W 12 under special VFR conditions. At 11:25hrs. aircraft reported that "We are little too high … we will be coming around". This was the last communication of the aircraft with the Ludhiana ATC. The aircraft flew approximately 400 m over the R/W 12 and than commenced right hand circuit while flying over tall trees of height approximately 100ft. on the airport boundary. As per the Duty ATCO the aircraft height while commencing the right hand turn was between 200-300 ft. Three minutes later at 11:28hrs. Ludhiana ATC gave a call to VHY for position but there was no reply. ATC Ludhiana contacted other ATS units in that area for the information about the aircraft. At 11:45hrs. it received information that aircraft had crashed at village Jugiana.

The airport fire services and city fire services were alerted. Approach to the crash site was difficult for fire services as they had to move through narrow lanes. In addition, airport fire services had to cross railway line running parallel to the airport which was closed during that period. After the fire was extinguished by fire services, the dead bodies were recovered and transferred to hospital by District Authorities.

Inspection at the accident site revealed that the aircraft approached the site in steep left bank. Accident site is the premises of an abandoned agro industry spread over an area of 28 acres. It was being used as a dumping ground for the ash of rice husk. The left propeller impacted the ground and separated from the engine shaft. The right propeller hit the long bushes at the height of around 10.5 feet simultaneously. The aircraft finally rested at a place thirty feet away from the point of first impact. After the first impact, the aircraft turned by almost 270 degree and impacted the ground in nose pitch down attitude. After the second impact the aircraft caught fire and a large portion of aircraft got burnt/ melted/ fused. There was no sign of bursting of fuel tanks.

Almost 900 ft. before the accident site there are two communication towers 40 m in height and in line with the accident site and also at same latitude as the threshold of R/W 12. **These towers have not been indicated in the obstruction chart of the aerodrome.** As per the eyewitness account positioned close to these communication towers, the aircraft made three orbits in this area. During the first orbit the aircraft was high, during the second orbit the aircraft had descended and flew over these two towers and during the third orbit it flew left of both the towers and at almost the same height as these towers. Subsequently, in unstabilised mode it crashed at the accident site. The fire started few minutes after the impact.

The crew died after the second impact due to collapsing aircraft structure and fire burns. Aircraft was completely destroyed due to impact and post impact fire.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	2	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	Nil	Nil	

1.3 Damage to aircraft

Aircraft King Air C90 VT-EHY was destroyed due to impact and post impact fire.

1.4 Other Damage

Nil

1.5 Personnel information

1.5.1 Pilot-in-Command

As per flight plan filed with the Chandigarh ATC he was Pilot in Command. However as per the Aircraft Maintenance engineer who did the departure, he occupied right seat in the cockpit. He was initially issued Indian ATPL on 08.02.1983. The ATPL was valid till 14.07.1985. He obtained FAA licence, date of issue 20th January, 2004 with the privileges of Airline Transport Pilot, Airplane Multi-engine Land. All Limitations and restrictions on the Indian Pilot License were applicable. His Indian ATPL was renewed on 13.04.2007 on the basis of 45 hours flying in last six months on FAA License which included IR/Day/Night Test on Beach Baron B-55 aircraft. The above inference is based on the submission of the pilot and not on the appraisal of his logbook. His log book was mutilated due fire therefore his 45 hrs of flying and checks could not be verified.

Details of Indian Licence

License type	:	ATPL
ATPL Valid up to	:	12.04.2009
Date of Issue	:	08.02.1983
Date of Birth	:	16.08.1946

Aircraft Ratings

As PIC	:	L-5, Sentnal, E18S, C18S, Pushpak
As Co-pilot	:	Nil
Open Rating	:	For all type of aircraft having AUW not exceeding 5700kgs
Any other	:	Last IR renewed on aircraft Premier-I, 25.12.2007 valid till 24.12.2008

Details of flying available in the file:-

Aircraft	PIC	Co-Pilot	Total
B-707	72	342	414
B-727	136	134	270
Fairchild	2843	309	3152

Experience on type : 9:20 hrs.
Flying during last 7 days: 04:50 hrs.
During last 24 hours : 50 minutes

As per the submission of Punjab Government, he had undergone familiarisation training on King Air C-90 aircraft with Capt. Nanda Senior Executive Pilot, Civil Aviation Department, Government of Haryana. However, Capt. Nanda has denied carrying out familiarisation flight for him.

1.5.2 Co-Pilot

As per the AME, the Co-pilot occupied the left seat. He was holding Indian CPL issued on 18.09.1989 and it had expired on 16.01.97. His Indian license was validated on 23.03.2008 after skill test on Cessna-152A aircraft. He was also holding FAA license dated 01.06.06 to exercise the privilege of Commercial Pilot and following are the endorsements on his FAA license:

Airplane Single & Multi Engine Land Instrument Airplane
BE-1900

Limitations:
BE-1900SIC Privileges only
BE-1900CIRC APCH – VMC only
King Air C-90 aircraft was not endorsed on his FAA License.

He was issued FATA for B1900D aircraft on 10.06.2008. However, on the basis of declaration by M/s Ran Air that he had 100 hrs. flying experience on King Air C-90 aircraft he was allowed to undergo skill check on type. King Air G90 was endorsed on his Indian license on 30-03.08. During investigation the company could not produce proof of his flying experience of 100 hrs. on type.

Since FAA licence does not mention all the aircraft below 5700 kg which are endorsed on the licence, therefore, to verify his endorsement on King Air C-90 aircraft his complete licensing records were obtained from FAA. As per the records received he had no endorsement on King Air C-90 aircraft. Thus it was a case of false representation by the company and the pilot. His proficiency to handle the emergencies is doubtful.

The log book of Co-Pilot was not recovered at the accident site. Neither Civil Aviation Department Government of Punjab could produce any copy of pilot's log book or details of his current flying experience. The tech log book as per the Punjab Government was on board so it also perished in the fire.

Indian License Details:

License type	:	CPL
CPL Valid up to	:	24.03.2013
Date of Initial Issue	:	18.09.1989
Date of Birth	:	06.03.1967

Aircraft Ratings:

As PIC	:	Cessna-152, 172, 310 & King Air C-90. King Air endorsed on 30.03.08
As Co-pilot	:	B1900D

Any other : Last IR renewed on aircraft King Air C-90 dated 30.03.2008, valid till 29.03.09

Flying Details : As per CA39 (till Feb, 2008)

	Single		Multi	
	Dual	Solo	Co-pilot	Solo
Day	303	129	664	---
Night	3 :15	109	-----	---

CA-39 does not mention flying experience on King Air C-90 aircraft individually.

Experience on type: 13:25 hrs.

Flying during last 7 days: 04:50 hrs.

During last 24 hours: 50 minutes

1.5.3 Both the crew had not flown to Ludhiana before. They were not aware of the many obstructions around the airport as they had not been published by the AAI. Records did not reveal of their any previous involvement in any accident or serious incident.

1.5.4 **Aircraft Maintenance Engineer**

AME is holding A&C Licence and was granted approval by Delhi Flying Club to carry out and certify daily inspection/ preflight/ transit/ post flight inspection of King Air C-90 aircraft fitted with P&W PT-6A-21 Engine, provided no defects is reported on the aircraft. Super King Air B-300 and P&W PT 6A-60A Engine aircraft is endorsed on his licence. As part of training he associated with work in progress of C of A renewal and carried out 7 transit inspections at Chandigarh on 09.10.2008 under the supervision of Quality Control Manager, M/s Delhi Flying Club, the Maintenance Agency. Procedure for granting approval is not included in the QC manual of the organisation.

1.6 Aircraft Information

1.6.1

Manufacturer	Beach Aircraft Corporation, USA	
Type	King Air C-90	
Constructors S.NO.	LJ-1008	
Year of Manufacturer	1982	
Certificate of Airworthiness	No.1761 and renewed on 06.10.2008 Valid up to 05.10.2009 Revalidated on the strength of FAA Export C of A No.E179464 dated 19.11.1982	
Category	Normal	
Sub Division	Passenger Aircraft	
Certificate of Registration	2232 dated 02.02.1983	
Owner	Government of Punjab Adviser, Civil Aviation, Government of Punjab Office 25, Sector 19A, Chandigarh	
Minimum Crew Required	One	
Maximum Authorised All Up Weight	4377.18 kg	
Last Major Inspection	Phase II/400 hrs./12 months approved Inspection on 25.09.2008	
Last Inspection Air frame Hrs. Since New	15 day / 25 hrs. carried out on 27.10.08 6530 :10 hrs.	
Air frame Hrs. Since last Cof A	12 :25 hrs.	
Engine	**Left**	**Right**
Manufacturer	Pratt & Whitney Canada	Pratt & Whitney Canada
Type	PT6A-21	PT6A-21
Serial No.	PCE24998	PCE24997
Hours Done Since New	5330 hrs.	4254 hrs.
TSO	1871	757 hrs.
Last Inspection Carried	50 hrs./30 days	50 hrs./30 days on 08.10.08

Out	On 08.10.08	
Last Major Inspection Carried out	Phase II/400 hrs./12 months approved Inspection on 25.09.2008	
Average Fuel Consumption	No Records Maintained	
Average Oil Consumption	No Records Maintained	
Propellers	**Left**	**Right**
Type	Hartzell HC-B3TN-3M	
Sr. No.	BUA 27864	BUA 30999
Last Overhaul	On 27.10.2008 at Indamer Mumbai	On 10.04.2008 at Indamer Mumbai
Hr. Since Over Haul	04 :50 hrs.	16 :45 hrs

The maintenance of the aircraft was contracted to M/s Delhi Flying Club. M/s Delhi Flying Club had approval to carry out inspection up to Phase IV check on King Air C-90A/90 aircraft including P&W PT6A-21 Engine installed thereon.

- The aircraft remained grounded from 27.01.2005 to 24.10.2006; from 24.10.2006 to 26.07.2007; from 12.10.2007 to 28.01.2008; 28.01.2008 to 21.04.2008; 21.04.2008 to 25.09.2008. During the period of grounding Engine Ground run was carried out and various aircraft schedules were carried out including CPCP.
- Aircraft was equipped with KLN 90B GPS. Its data base is to be updated at the interval of 28 days. However there is no record when the data base on this aircraft was updated.
- M/s Delhi Flying Club/Punjab Government has not maintained fuel/oil consumption record and defect reporting register. Flight report book as per the Punjab Government was on the aircraft and got destroyed on the post impact fire. Therefore, snag history of the aircraft could not be analysed. However, copies of Tech. Log for 08.10.08 & 09.10.08 dates were available wherein no snag was indicated.
- Scrutiny of records revealed that on 28.01.2005 burning smell and chattering noise was felt from Fuel Control Panel in cockpit and subsequently fuel shut off valve circuit breaker popped out. The snag was rectified with the introduction of two plugs instead of one original plug. As per DFC the original pin connector was not available with the manufacturer. The Raytheon Company intimated that

they do not have a kit for installing different P/N connectors at Fuel Control Panel. The installation drawing was approved by Director Airworthiness, Delhi Region.

1.6.2 **General Description**

The King Air C-90 is an all-metal, low-wing, twin-engine turbo-propeller airplane with retractable landing gear. The airplane is equipped with conventional ailerons, elevators and rudder, for roll, pitches and yaw control. The airplane is equipped with dual controls for the pilot and co-pilot. The ailerons and elevators are operated by control wheels interconnected by a T-bar.

Flight instruments are arranged in a group directly in front of the pilot and the co-pilot. Complete pilot and co-pilot flight instrumentation is available, including dual navigation systems, two course selectors, dual gyro horizons and dual turn and slip indicators.

The annunciator system consists of a warning/caution/advisory panel. The warning (red), caution (amber) and advisory (green) annunciators are centrally located in the glare shield. A red MASTER WARNING flasher, amber MASTER CAUTION Flasher is also part of the system. If the fault requires the immediate attention and reaction of the pilot, the appropriate red warning annunciator in the panel illuminates and the MASTER WARNING flasher begins flashing.

Switches for the landing lights, taxi lights, wing ice lights, navigation lights, rotating beacons, wing tip and tail strobe lights, are located on the pilot's right subpanel. They are appropriately identified as to their function.

Tail floodlights, are incorporated into the horizontal stabilisers and are intended to illuminate both sides of the vertical stabiliser. A switch for these lights, placarded LIGHTS – TAIL FLOOD – OFF, is located on the pilot's right subpanel.

1.6.3 Load & Trim Sheet

Crew did not prepare load & trim sheet for this and earlier flights. However, based on available records Take off load and trim position was calculated and found to be with in limits.

1.6.4 P&WC Engineering Analysis of Torque Required to Fracture PT6A-21 Propeller Shaft

Manufacturer was requested to provide data regarding torque/force at which failure of the propeller shaft will take place. As per them the static torque required to shear the prop shaft is over 17 times the normal engine operation at take off power of 550 SHP at 2200 RPM propeller speed. For this calculation, minimum material dimensional conditions were used and the calculations were done at the location in between the propeller and front reduction case. This analysis assumed full properties of the material, no defects or cracks and no fatigue. In order to fracture the prop shaft, the torque has to be very high. At the ultimate yield level, the torque required to shear the prop shaft is approximately 277333 in-lbs, or the equivalent of 9500 SHP at 2200 RPM.

1.7 Meteorological information

Chandigarh weather is not significant to investigation. The weather existing at Ludhiana, as per the Meteorological Department, Ludhiana was as follows:-

1.7.1 METAR 10:30 Hrs.

Visibility	-	1500 m.
Winds	-	090/04 kts
Clouds	-	SKC
Temperature	-	25°C
DEW Point	-	18°C
QNH	-	1014 HPA

1.7.2 METAR 11:20 Hrs.

Visibility	-	1500 m.
Winds	-	090/04 kts
Clouds	-	SKC
Temperature	-	27°C
DEW Point	-	18°C
QNH	-	1013 HPA

1.7.3 METAR 12:30 Hrs.

Visibility	-	1400 m..
Winds	-	090/04 kts
Clouds	-	SKC
Temperature	-	28°C
DEW Point	-	16°C
QNH	-	1013 HPA

1.8 Aids to Navigation

Aircraft is equipped with modern navigation aids viz. VOR, DME. Ludhiana Airport has NDB with frequency 380 kHz and is available within notified watch hours at the airport. There is no IAL procedure for this aerodrome and only VFR operations are permitted.

1.9 Communication

The aircraft is equipped with VHF set for communication. Ludhiana Airport is equipped with STD telephone, intercom, walky talky etc. VHF frequency 122.3 MHz, main and stand by two sets are available for two way communication with the aircraft. Telephone/Intercom and walky-talky is available for communication with other units at the airport. Hotline with other ATS units, fire station and police station are not available. All the ATC communication facilities are not being recorded. The recorder was being used on trial basis. The data recorded was not clear.

1.10 Aerodrome information

1.10.1 Ludhiana Airport is situated 15 km. South-East of Ludhiana. The airport is operational for limited hours and is VFR aerodrome. No night landing facilities are available at the aerodrome. **Aerodrome control tower location does not give 360 degree view.** R/w 12 beginning is not visible due to presence of structures higher

than the floor level of control tower in the vicinity in its existing position. Hence, visual surveillance of r/w 12 beginning, operational area and in the backside of the aerodrome control tower gets limited. Also from R/w 12 and adjacent operational area, aerodrome beacon located at the top of control tower is also not visible.

Only Aerodrome control services are provided at Ludhiana Airport having a control zone up to 3,000 ft. and transition altitude up to 4,000 ft. Though there is no standard procedure for the approach control services for aircraft approaching or departing from Ludhiana Airport, however, normally, the incoming/outgoing aircraft above 3,000 ft. are being controlled by either Chandigarh or SU Barnala (Alfa control).

ATC watch hours are limited between 11:30 to 15:30 hours as there is no scheduled operation at the airport. Coordination procedure with other neighbouring ATS units including Air Force has not been established.

Physical Characteristics

On R/w few cracks and depressions were observed at some places. The physical characteristics are as follows:

R/W Orientation	R/W Dimension	R/W PCN	Txy Way Width	Apron PCN
12/30	1463x30m	11/F/C/X/U	15 m.	11/F/C/X/U

Elevation of the Aerodrome : 834 ft.
R/w Strip : 75 m on both sides of r/w center line
R/w 12 is displaced by 68 m and R/w 30 by 77 m.

1.10.2 Rescue and Fire Fighting Services

CAT IV Rescue and Fire Fighting Services have been provided at the airport. One CFT and one rapid vehicle with water capacity 800 lts. and ambulances are available. Discharge rate of fire and rescue vehicle (Super Tetra) is 3200 lts. /min. For replenishing the CFT water source a tank of capacity 25,000 lts. is available. Adequate stock of the foam compound (protein), DCP CO2 is available. Communication with ATC and other units is through walky talky. There is no city fire service near to aerodrome. **The protective fire suits were**

not available for the fire personnel. Full scale aerodrome emergency exercises at the interval of two years and partial emergency exercise in the intervening year are not being conducted.

1.10.3 Obstructions

There are trees in the approach path on both R/w closed to r/w strip protruding the obstacle limitation surfaces. Approximately 40 m. BSNL and Reliance tower of same height were observed in the base leg of R/w 12. In addition, number of other towers, high tension electric towers, chimneys, buildings and structures were observed in the vicinity of the aerodrome which has been erected after the survey conducted in 1999 by AAI. Therefore, these obstructions are not available in the obstruction chart of Ludhiana Airport. No OLS survey has been conducted since 1999.

1.10.5 Meteorological Services

Class III Met Office of IMD with trained manpower is available and provides current weather report during the notified watch hours. Observatory has been provided with equipments such as barometer, anemometer and thermometer for temperature due point and wind direction and speed. Visibility is reported through pre-determined land marks and clouds by eye observation. **The landmarks available with the Met Office are up to 4,500 m only. It appears that the visibility beyond 4,500 m is not being provided at the airport. Being VFR airfield, it is desirable to have more number of pre-determined landmarks for observation of visibility 5,000 m and more in all directions.**

1.11 Flight recorders

The aircraft is not equipped with either CVR or DFDR.

1.12 ATC Recorders

1.12.1 ATC communication record of Chandigarh

At 10:56:2hrs. aircraft was cleared for take off from R/W 11 as per flight plan route, initially for a climb to 2000 ft due traffic. At 11:06 hrs. when aircraft was more than eighteen miles from Chandigarh it was given further climb to 6000 ft.

At 11:10:37 hrs. aircraft confirmed over IBANA and turning right and left for Ludhiana and had attained 6000 ft. At 11:12:38 hrs. changeover to Ludhiana was approved.

1.12.2 Communication Recording of SU Barnala

At 11:11 hrs. SU Barnala requested an airforce aircraft which had taken off from Chandigarh after HY to check with ATC about the identity of the traffic which was maintaining ahead of it and heading towards Ludhiana. At 11:15hrs. VT-EHY gave a call on channel alpha and informed that it was 4.2 miles inbound to Ludhiana at Level 060 and requested for descend. HY was asked to changeover to Ludhiana and descend in coordination with Ludhiana ATC.

1.12.3 Radar Recording of SU Barnala

The radar recording of SU Barnala was obtained and on its basis the position of aircraft w.r.t. Barnala was determined as given below:

Time (IST)	Bearing / Range	Speed	No. On the Map
1109	059/48	171	1
1110	056/47	160	
1111	053/45	178	2
1112	052/42	161	
1113	050/41	169	3
1114	047/38	167	
111430	045/37	171	4
1115	044/36	183	
111530	041/35	171	5
1116	040/34	166	
111630	038/33	142	6
1117	038/33	120	
111730	035/34	138	7
1118	037/35	139	

1.12.4 ATC communication record of Ludhiana

Aircraft came in contact with Ludhiana at 11:16 hrs. and reported that they were at eight miles and requested for descent clearance, stating that they were at 7000 ft to 6000 ft. Ludhiana informed that VFR not approved. At 11:18 hrs. HY informed that they were cleared by Alpha control for direct approach and requested for R/W in use. TWR informed that R/W 12 was in use. At 11:19hrs. aircraft reported overhead. and at 11:22hrs. it reported 2 mils from RWY and TWR asked to confirm if field was in sight. At 11:23hrs. aircraft reported that they were over the field and make circle to land on 12. At 11:25 hrs. it informed that "we are Little too high … we will be coming around … OK" .At no stage aircraft intimated of any emergency or failure of any system.

1.12.5 Correlation of Radar Plot and Radio Communication

At 11:10:31 hrs. aircraft turned left for Ludhiana. At 11:15:30 hrs. it flew abeam R/w 30 towards R/W12 when crew reported to Ludhiana and subsequently informed that they were eight miles and at 7000 ft to 6000 ft and requested descent clearance. At 11:17 hrs. it commenced right hand turn after crossing T/H R/W 12 and subsequently requested for R/w in use. At 11:19 hrs. while it was in right hand turn it reported overhead this time. Thereafter at 11:22 hrs. it reported 2 miles from the R/w and at 11:23 hrs. the aircraft reported over the field and informed that it will make a circle to land on R/W 12. Apparently, the aircraft approached R/W12 from right.

1.13 Wreckage and Impact Information

Accident site is approximately 0.75 km from the R/W 12. The coordinates of the accident site are N 30° 51´13.38", E 075° 56´18¨.Accident site is the premises of an abandoned agro industry spread over an area of 28 acres. It was being used as a dumping ground for the ash of rice husk.

Aircraft approached the accident site in steep left bank. The left propeller impacted the ground and separated from the engine shaft due to bending and the right propeller hit the long bushes at a height of around 10.5 feet. One of the left propeller blades was found buried in the ground thought attached to the hub. Aircraft finally rested at a place thirty feet away from the point of first impact. After the first impact the aircraft turned almost 270 degree and impacted the ground in nose pitch down attitude. At the point of first impact a large crater of a width of approx. 5 feet was formed. At approx. 2 ft. from the point of first impact portions of the engine bottom fairing was found in broken condition and no sign of burn were observed on it. After the second impact the aircraft caught fire and a large portion of aircraft got burnt/ melted/ fused. Before the point of first impact no aircraft part/component was recovered along the direction of flight. Detailed wreckage dig is given as appendix 'A'.

Wreckage site with direction of flight indicated

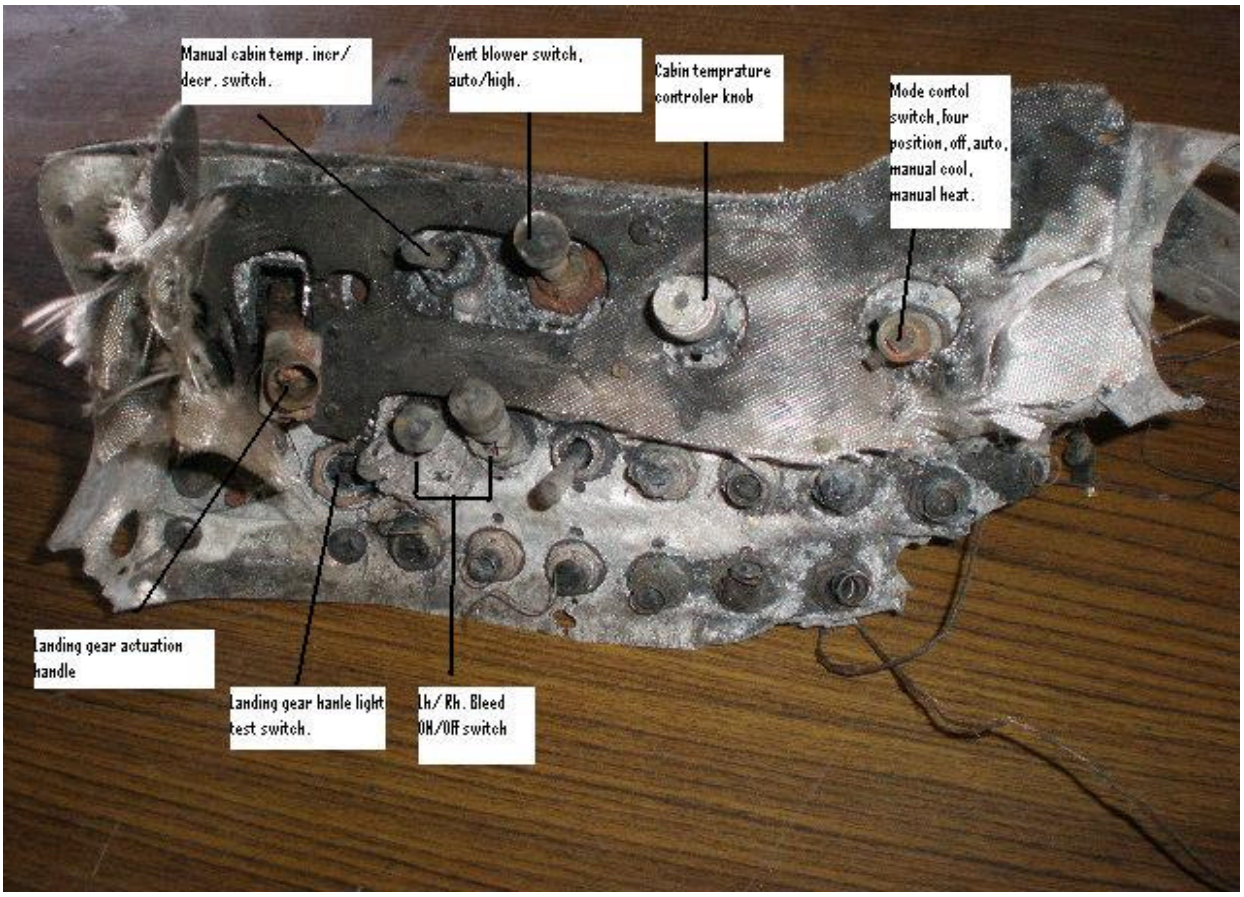
1.13.1 Fuselage

a. Cockpit: After the impact, nose and cockpit section caught fire and was fully

consumed in it. Few of the cockpit instruments, avionics equipments were recovered and portion of crew seats were found in the centre section of the fuselage.

b. **Following items were recovered** :

Pilot seat back rest, Co-pilot seat back rest half burnt, Control column of both side , Engine control Linkages, DR Compass, OAT Probe, Altimeter,
Artificial Horizon, NAV Indicator, Control Column Chain and Sprockets
Avionics Equipments Seven Nos., Cockpit Instruments Eleven Nos.,
Portion of Enunciator Panel Landing Gear Control Switch Panel



Landing Gear Control Switch Panel

Position of switches on Landing Gear Control Switch Panel

Switches	**Position**
Landing gear actuation handle	Down Position
Manual cabin temperature control switch	Center
Vent blower switch	Auto
Cabin temperature knob	------

Mode control switch	------
Landing gear handle light test switch	Neutral
Lh/ Rh bleed control switch	On

All these instruments were in burnt condition, therefore no reading could be taken. Power control pedestal was found with burnt control linkages. Flap control lever could not be recovered, probably burnt.

c. **Centre Section**: Centre Section of the fuselage was fully burnt. Some portion of the belly skin was available, front and rear spar passing through centre section was visible. A portion of a passenger seat was recovered from this section.

d. **Rear Section of the Fuselage (from FS 228.75 to 298.00):**
Left side entry door in locked position along with belly skin and portion of fuselage section below teardrop window recovered in a discoloured condition due to heat. Right side and the top portion was fully consumed in fire and molten metal puddle found in downward direction. Control Cables were recovered in position.

e. **Empennage Section**:
Portion of dorsal fin and vertical stabilizer with portion of rudder attached but bent towards right, horizontal stabilizer with elevators attached, recovered. A portion of right hand side stabilizer and elevator found broken after hitting a tree and lying nearby at distance of approx. 2 feet. Complete section was discoloured due to heat. Control Linkages for rudder and elevator found intact with cables attached. At few portions molten metal puddle dropping downward observed. Anti collision light on stabilizer had separated but lying near the empennage section. Empennage section was resting on brick embankment of approx. 4 feet height. Trim Tab on elevator found slightly downward. Elevator was found in level condition.

Closer view of wreckage indicating empennage, fuselage, L/G, engine, portion of right wing

1.13.2. Wing Section

a. Centre section of the wing up to aileron attachments on both sides fully consumed due to fire, though front and rear spar were available. RH Front spar was twisted and bent inward. Puddle of molten aluminium alloy and fusion of some portion of fuselage was observed in this section. Flap area on both sides consumed due to fire. One Flap track of LH Flap recovered in fused condition. Two inner assembly of flap actuator of LH Flap recovered without the outer casing.

b. Left Wing outer Section up to WS 188.907 to wing tip was severely impacted at the leading edge and grazing marks of vegetation found on the impacted portion. Discoloration due to heat observed on skin.

c. Right Wing outer Section up to WS 188.907 to wing tip was severely impacted at the leading edge. Discoloration due to heat observed on skin.

1.13.3 Landing Gear

a. Nose Landing Gear was recovered in three pieces in separate sections. Shimmy Damperer, steering link, upper torque link attached to upper strut recovered. Portion of torque knee wheel hub recovered attached to lower strut. Drag brace found in extended and locked position separated from strut assembly. Paint burnt and fuselage attachment not recovered.

b. Main Landing Gear was recovered in two pieces in separate sections, upper torque link attached to upper strut recovered. Portion of torque knee wheel hub were attached to lower strut. Drag brace found in extended and locked position attached to upper strut. Portion of retraction mechanism tube found attached on both sides. Landing gear attachment found attached to the upper strut assembly.

1.13.4 Engines and Propeller

Both the engines had separated from the aircraft and were recovered in the direction opposite to the direction of motion.

1.13.4.1 **Left Hand Engine (S.No. PCE 24995)**

Propeller had separated from the engine shaft due to bending load on the shaft. All the propeller blades were bent backward and centre of bend was near 1/3 of blade span. No bending or damage near tip or any appreciable twist of the blades seen.

The engine displayed severe fire and impact damage, including complete fire consumption of the reduction gearbox housing and the accessory gearbox housing. The propeller shaft was impact fractured and the propeller was recovered separately. Propeller mounting flange found attached, bolts and locking found intact with propeller assembly. Propeller governor found attached along with linkages; linkages were free to move; Accessory gear box damaged due to impact and some portion melted in fire; Oil lines found broken; line union found attached; oil line from reduction gear box found damaged and separated from lower portion of the engine. Fuel nozzle interconnect and transfer lines found attached; three interconnect lines on the lower portion found melted; fuel manifold and pipelines

found connected. ITT thermo couple connection and its temperature compensation probe found connected. Engine Driven Fuel Pump along with its drive gears from accessory gearbox, filter assembly found separated from accessory gear box. Igniters and ignition cables found attached. Major portion of the accessory gear box damaged due to fire.

1.13.4.2 **Right Hand Engine S.No. 24997**,

Propeller found attached to engine, one propeller blade found submerged in the ground, second propeller blade found burnt melted and molten metal dropping downwards. Third propeller blade found bent in the forward direction and broken at the tip. Third blade found bent at two places. Propeller spinner found damaged.

The engine displayed severe fire and impact damage, including complete structural separation of the power section, gas generator section, and accessory gearbox. The airframe propeller, torque manifold, and starter generator remained attached. Top portion of engine exhaust section found bent inward. Engine exhaust section along with reduction gear assembly separated from turbine section at flange area due to impact. Fuel nozzle interconnect tubes found attached fuel manifold along with its fuel line found connected at manifold, whereas the other end of fuel line found damaged and broken. Intake screen found separated and lying nearby. All hoses found burnt but unions connected to the respective ends. Control Lever linkages eye ends found attached, whereas control lines found melted.

1.13.5 **External Lights**

Filament type External Lights Viz. Anti-collision light at the underside of the fuselage, Wing tip lights were examined and it was observed that at the time of impact they were not supplied with electricity.

1.13.6 **Flap actuator assembly of LH Flap**

Flap actuator assembly of LH Flap was recovered from wreckage without the outer casing. To ascertain the flap poison it was compared with a serviceable aircraft at the maintenance facility of M/s Inter Globe. Based on examination it was concluded that the flaps were in retracted poison.

1.14 Medical and Pathological Information

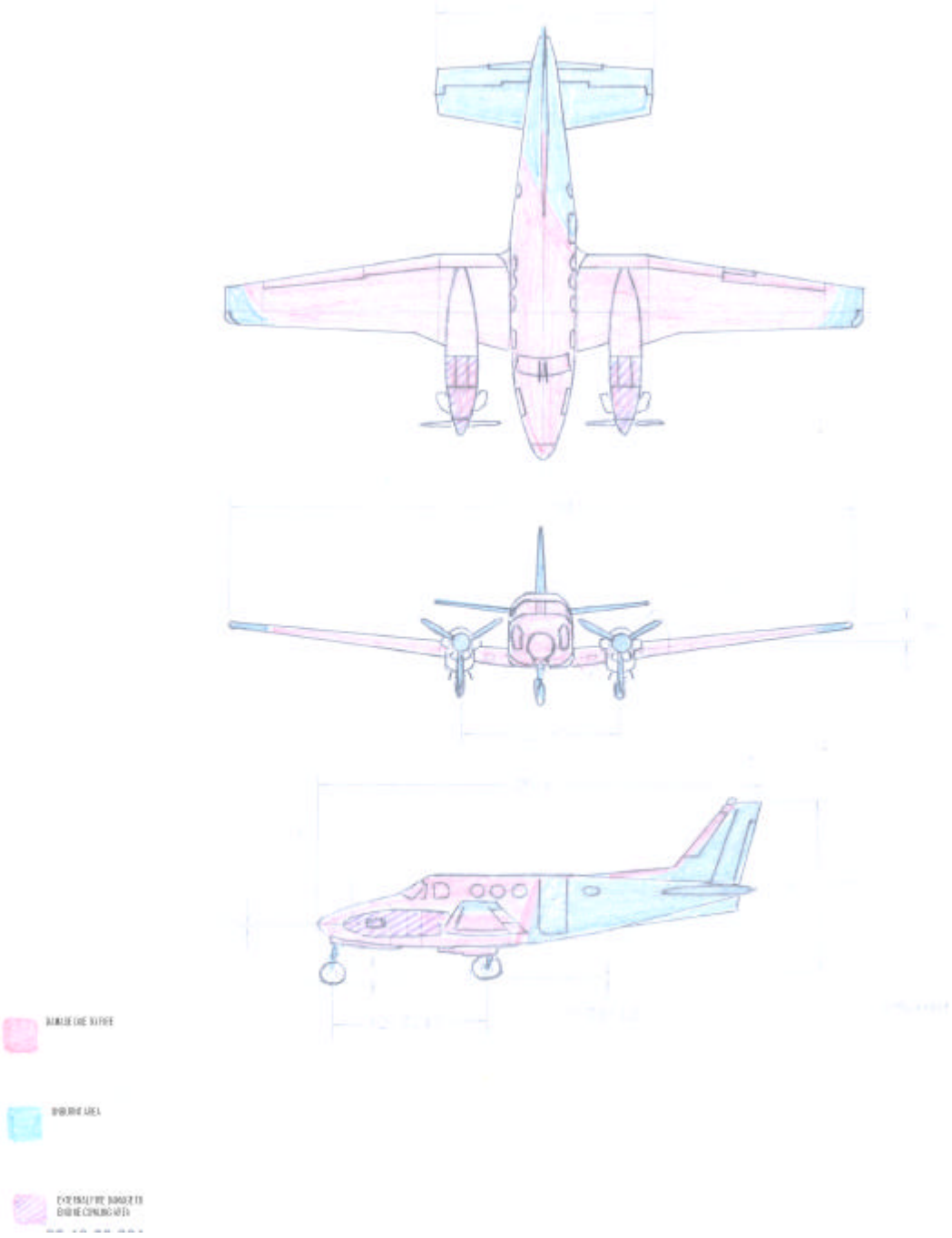
Both the pilots were completely charred and bodies were in Pugilistic attitude with superficial to deep burns. Skull including upper part of the face was found missing from the charred bodies. Fracture in the forearm and both the femur. In the lungs mark congestion on both sides and ingestion of carbon particles along with serous fluid present. The death was caused due to extensive (100%) burn.

The post mortem report was referred to DMS (CA) for his opinion. The opinion expressed by him is presented below:

I. The PM report mentions markedly congested lungs with carbon particles and serous fluid may indicate inhalation of smoke prior to death. The cause of crash/pilot incapacitation may, therefore, result from in flight fire/smoke in the cockpit.
II. The PM report also mentions a completely charred body in a pugilistic attitude indicating anti-mortem burns. It may, therefore, indicate that pilot was alive at the time of impact/post-crash fire.
III. A more detailed autopsy in the presence of an aviation medicine specialist is likely to provide important clues for the cause of accident.

1.15 Fire

A large portion of aircraft was found burnt/ melted/ fused due to the fire. The examination of the wreckage revealed that the fire was post impact. There was no sign of in-flight fire. The eyewitness also confirmed that no fire was seen before the impact. Probably after the second impact the fire started. Due to impact the nacelle fuel tanks got ruptured. The fuel coming out of the ruptured fuel tanks came in contact with the hot engines and thus caused fire.



Description of fire damage

1.16 **Survival Aspects**

On 29.10.08, day of the accident, the aircraft at 11:25 hrs reported "we are little too high we will be coming around" this was the last communication of the aircraft with the Ludhiana ATC. The aircraft flew approximately 400 m over the

R/w 12 and then commenced right turn. At 11:28hrs Ludhiana ATC gave calls to VHY for position but there was no reply. ATC Ludhiana contacted other ATS units in that area for information about the aircraft. Finally, at 11:45 hrs. ATC received information from CID Inspector posted at the airport that aircraft crashed at village Jugiana. The airport fire services and city fire services were alerted and both fire services reached the crash site at 11:50 hrs. . Aircraft was engulfed in intense fire. At 12:25hrs. CFT at accident site reported that fire was completely extinguished using 4000lt of water and 300lts of foam.

To reach the site the airport fire and rescue service had to cross the railway line which was closed at that time and then had to break the gate of the factory premises to reach the crash site. Approach to the crash site was difficult for fire services as they had to move through narrow lanes. After the fire was extinguished airport fire services were called back to airport. Both the dead bodies were recovered from the main wreckage. Removal of the dead bodies from the wreckage and their transportation to hospital was carried out by district administration.

In the present case the fire at the time of accident was so intense that the survival of the occupants was almost impossible.

1.17 Tests and Research

1.17.1 Forensic Report

Forensic Examination of the samples collected from the site was carried out by Forensic Science Laboratory, Punjab, Chandigarh. In their report, they have ruled out the possibility of plane crash due to sabotage.

1.17.2 Fuel Sample Report

A sample of fuel of the same batch as was used on the aircraft was obtained and subjected to full specification test at the Fuel Lab in the O/o Directorate General of Civil Aviation (DGCA). As per the examination, report received there was no abnormality in the sample and it passed all the specification tests.

1.17.3 Metallurgical Examination Report

Fracture surface of both the ends of ruptured propeller drive shaft of left engine were examined in the DGCA laboratory. As per the report the fibrous, grey and

slant fracture surface and crescent shape rubbed area observed at the mating end of the propeller drive shaft, suggests that the drive shaft has failed in bending. Crescent shape area has been formed by running of mating fractured surfaces due to compression during bending. Probably the bending load has been imposed from the opposite side of the crescent shape area, on the propeller shaft causing its failure under bending overload condition. The leading edge of blades found to be clear of any dent with upper surface scratched and polished.

As per the report, the propeller drive shaft has failed under bending overload condition.

1.17.4 Engine Tear Down Inspection

Both the engines were strip examined in association with the representative of M/s Pratt & Whitney at Punjab Government Maintenance Facility at Patiala. Both the left and right hand engines displayed contact signatures to their internal components characteristic of the engines' developing power at the time of impact in middle to high power range.

The engines displayed no indications of any pre-impact anomalies or distress that would have precluded normal engine operation prior to impact. The salient observations made during the strip examination are as follows:

Note: -All positional references are in relation to view from aft looking forward. Upstream and downstream references are in relation to gas path flow from the compressor inlet to exhaust.

1.17.4.1 Left Hand Engine Examination

(i) External Condition

(i)(a) External Cases

Reduction Gearbox: The housing was completely consumed by fire, exposing the reduction gearing. The propeller shaft was impact fractured immediately aft of the propeller mounting flange. The propeller governor housing was completely consumed by fire. The propeller governor input lever was continuous with the airframe linkage. The propeller governor drive shaft and flyweight assembly was

exposed. The propeller over speed governor and the Np tacho were not recovered.

Exhaust Duct: Displayed moderate compressional deformation. The duct and the exhaust stubs displayed no indications of external pockmarks or dimples.

Gas Generator Case: Displayed no apparent deformation. The inlet plenum was completely consumed by fire, exposing the compressor inlet, No. 1 bearing housing, and accessory gearbox input shaft. The fuel manifold was in place. The transfer tubes were melted or consumed by fire. The compressor bleed valve was in place.

Accessory Gearbox: The accessory gearbox was completely consumed by fire. The fuel pump drive gear and the high pressure fuel pump with the fuel control unit drive assembly were recovered separately. The remainder of the fuel control unit and rest of the accessory gearbox mounted controls and accessories were not recovered or were consumed by fire.

***Engine left hand view*.**

(i)(b) **Power Control and Reversing Linkage**

The linkage was in place and continuous, with severe fire and impact damage. The linkage connections from the beta block, beta valve, Nf over speed reset, controls cam box, and fuel control input linkages were intact, with all locking devices in place.

(i)(c) **Pneumatic Lines**

Compressor Discharge Air (P3): The P3 line was continuous, with fire and impact damage, from the gas generator case fitting to the fuel control unit elbow fitting. All connections and locking devices were intact.

Power Turbine Control (Py): The Py line was continuous, with fire and impact damage, from the fuel control unit elbow fitting to the propeller governor elbow fitting. All connections and locking devices were intact.

(ii) **Disassembly Observations**

(ii)(a) **Compressor Section**

The compressor 1st stage blades, stator, and shroud were intact. The blade tips and shroud displayed light circumferential rubbing due to their making radial contact. The No. 1 bearing housing was intact. The bearing could be rotated by hand.

(ii)(b) **Combustion Section**

Combustion Chamber Liner: Displayed no indications of operational distress.

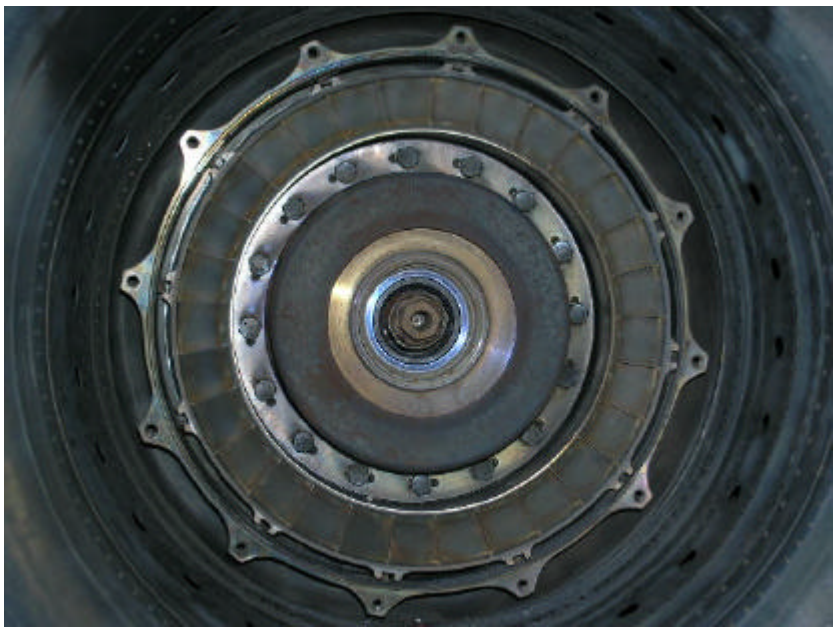
Small Exit Duct: Observed in-situ. Displayed no indications of operational distress.

Combustion chamber liner and compressor turbine, in-situ.

(ii)(c) **Turbine Section**

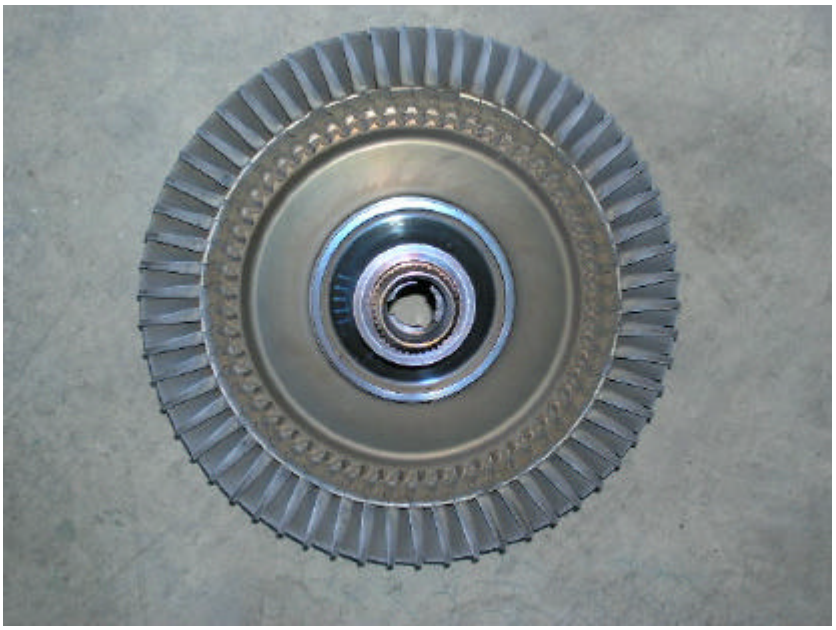
Compressor Turbine Guide Vane Ring: The vane airfoils displayed no indications of operational distress. The vane ring inner drum displayed circumferential rubbing due to axial contact with the compressor turbine.

Compressor Turbine Shroud: Displayed light circumferential rubbing due to radial contact with the compressor turbine blade tips

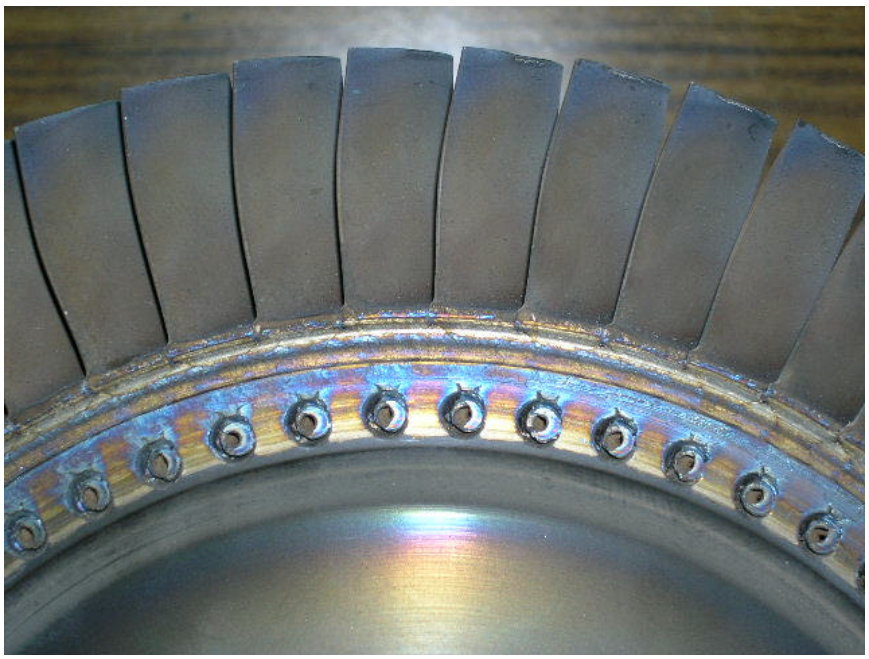


Compressor turbine guide vane ring and small exit duct, in-situ.

Compressor Turbine: The blade airfoils were intact. The disc upstream side displayed circumferential scoring to the blade platforms due to axial contact with the compressor turbine guide vane ring. The disc downstream side outer rim displayed heavy circumferential rubbing and machining, with frictional heat discoloration and material smearing, due to axial contact with the power turbine guide vane ring.



Compressor turbine, upstream side.



Compressor turbine, downstream side

ITT Probes, Busbar, and Harness: Displayed no indications of distress.

Power Turbine Housing: Displayed no indications of distress.

(ii)(d) **Reduction Gearbox**

The reduction gearing was examined as exposed by the fire consumption of the reduction gearbox housing. The gearing displayed no indications of operational distress. The propeller shaft was fractured immediately aft of the propeller mounting flange. Unaided visual examination of the fracture surface displayed no indications of fatigue or other progressive fracture mechanism and indicated torsional and bending failure.

Propeller shaft, aft fracture face.

(ii)(e) **Accessory Gearbox**

The accessory gearbox housing was completely consumed by fire. The accessory gearbox drive shaft and drive gear were in place, and displayed no indications of operational distress. The high pressure fuel pump drive was recovered, and displayed no indications of operational distress. No other accessory gearing was recovered.

1.17.4.2 Right Hand Engine Examination

(i) External Condition

Engine left hand view.

(i)(a) **External Cases**

Reduction Gearbox: Housing was essentially intact. The lower housing and chip detector mounting boss were impact fractured. The propeller shaft was intact. The propeller governor, over speed governor and the Np tacho were in place, with impact damage. The propeller governor input lever was continuous with the airframe linkage.

Exhaust Duct: The duct was torn and completely separated immediately forward of flange "C", exposing the power turbine guide vane ring, compressor turbine, and the power turbine. The outer plenum remained attached to the gas generator case. The "C" flange retaining bolts were fractured and the flange partially separated from the gas generator case around the right hand circumference. The inner plenum remained attached to the reduction gearbox. The plenum was deformed sharply to the right and upward.

Gas Generator Case: Displayed severe compressional deformation. The inlet case support struts and plenum were impact fractured, exposing the compressor inlet and No. 1 bearing housing. The fuel manifold was in place. The compressor bleed valve was in place.

Accessory Gearbox: The accessory gearbox lower circumference was consumed by fire. The oil to fuel heater, high pressure fuel pump, fuel control unit, and ignition exciter were in place, with impact damage. The Ng tacho was not recovered.

(i)(b) **Power Control and Reversing Linkage**

The forward linkage connections from the beta block, beta valve, and Nf over speed reset linkages were intact to an impact fracture aft of the flange "A" fitting. The aft linkage fittings from the controls cam box, and fuel control input linkages were intact. All connections were intact, with all locking devices in place.

(i)(c) **Pneumatic Lines**

Compressor Discharge Air (P3): The P3 line was impact fractured forward of the rear fire seal, displayed fire and impact damage. The gas generator case fitting was intact. The fuel control unit elbow fitting was fractured from the fuel control unit mounting boss. All connections and locking devices were intact.

Power Turbine Control (Py): The Py line was impact fractured forward of the rear fire seal and displayed fire and impact damage. All connections and locking devices were intact..

(i)(d) **Chip Detectors and Filters**

Reduction Gearbox Chip Detector: Not recovered.

Oil Filter: Displayed fire and heat damage. There were no indications of pre-impact contamination..

Fuel Filter: The inlet screen displayed heat damage. There were no indications of pre-impact contamination. The outlet filter disintegrated due to fire and heat damage.

(ii) Disassembly Observations

(ii)(a) Compressor Section

The compressor 1st stage blades, stator, and shroud were intact. The blade tips and shroud displayed circumferential rubbing, with frictional heat material smearing, due to their making radial contact. The No. 1 bearing housing was intact. The bearing could be rotated by hand.

Compressor 1st stage and No. 1 bearing housing, in-situ.

Compressor 1st stage blades and shroud, detail.

(ii)(b) Combustion Section

Combustion Chamber Liner: Impact deformation compressed the liner around the power turbine housing. The liner displayed no indications of operational distress.

Large Exit Duct: The flame pattern indications appeared normal. Displayed no

indications of operational distress.

Small Exit Duct: Displayed no indications of operational distress.

Gas generator case interior, large and small exit ducts, and compressor turbine, in-situ.

(ii)(c) **Turbine Section**

Compressor Turbine Guide Vane Ring: The vane airfoils displayed no indications of operational distress. The van ring inner drum displayed heavy circumferential rubbing due to axial contact with the compressor turbine.

Compressor Turbine Shroud: Displayed heavy circumferential machining due to radial contact with the compressor turbine blade tips.

Small exit duct and compressor turbine guide vane ring, in-situ.

Compressor Turbine: The blade airfoils leading edges were intact. The disc upstream side displayed heavy circumferential scoring to the blade platforms due to axial contact with the compressor turbine guide vane ring. The disc downstream side outer rim and blade airfoil trailing edges displayed heavy circumferential rubbing and machining, with light frictional heat discoloration and material smearing, due to axial contact with the power turbine guide vane ring and the power turbine.

Compressor turbine upstream side, detail.

Compressor turbine downstream side, detail.

ITT Probes, Busbar, and Harness: Displayed impact deformation. All of the ITT probes were impact fractured.

Power Turbine Housing: Displayed impact deformation.

Power Turbine Guide Vane Ring and Inter stage Baffle: The vane ring was disintegrated due to contact between the compressor and power turbines. The inter stage baffle was separated and was not recovered. The vane airfoils displayed no indications of operational distress. The upstream side vane ring inner drum displayed heavy circumferential rubbing due to axial contact with the compressor turbine. The downstream side vane ring inner and outer drums displayed heavy circumferential rubbing due to contact with the power turbine.

Power Turbine Shroud: The shroud and housing displayed severe circumferential rubbing and machining, with frictional heat discoloration and material smearing, due to radial contact with the power turbine blade tips.

Power turbine shroud and housing.

Power Turbine: The blade airfoils were displaced from their serrated fixings and were not recovered. Three adjacent blade platforms remained attached to the disc, and were displaced forward in their serrated fixings. The blade airfoils were fractured at their roots. The platform faces and the disc hub displayed severe circumferential rubbing and machining due to contact with the compressor turbine, through the power turbine guide vane ring

(ii)(d) Reduction Gearbox

The reduction gearbox was separated at flange "A" for access. The 1st and 2nd stage gearing displayed no indications of operational distress.

(ii)(e) Accessory Gearbox

The accessory gearbox was not disassembled. The drive shaft assembly was intact and continuous with the input gear.

1.17.5 Tear Down Inspection of Propellers

Tear down inspection of both the propellers and hub assembly was carried out in association with the M/s Indamer Co. Pvt. Ltd. who are authorized for the propeller overhaul. The left propeller which had separated from the engine was observed in fine pitch condition. The propeller blades were numbered from 1 to 3 with No.1 blade having maximum twist and less of bending. The strip examination of left propeller hub revealed that lower face of the piston was resting on No.3 blade counter weight on account of which the piston could not move on to bottom of the cylinder resulting in all the three blades remaining in fine pitch position. Under normal circumstances the propeller detached at propeller shaft of engine at attach flange which is completely broken off, should have all the three blades turned to 'feathered' position due to the action of feathering springs whose physical conditions are absolutely normal and intact without breakage. This is the evidence to prove that the propeller shaft broke only after the propeller received heavy impact. If the propeller shaft had first broken in flight and the propeller had detached and fallen out, the propeller blades should have been in 'feathered' position, in the absence of supply of engine oil to the piston and the opposing feathering spring reaction to extend from 'compressed' position.

1.17.6 Tear Down Inspection of Landing Gear Motor, Flap Motor Assembly, Vent Blower Motor

Tear down inspection of landing gear motor, flap motor assembly, vent blower motor was carried out at M/s Indamer Co. Pvt. Ltd. Mumbai. No significant deficiency / abnormality was observed in any of the three motors which could have led to their malfunction, arcing or source of smoke.

Details of Observations are as below:

Landing Gear Motor:

A) External Observations:

Landing gear motor was found intact, no external damage was found, however

signs of external burning observed, identification plate was found burnt, motor was stiff to rotate, insulation of electrical leads found burnt.

Insulation and continuity check was carried out on the leads and following was the observations:

1. Grounding lead checked for continuity to the body and found satisfactory.
2. Clockwise lead checked for continuity and found Satisfactory.
3. Counter Clockwise lead checked for continuity and found Satisfactory.
4. No shorting was observed.

B) Strip Examination

Motor was stripped and following was the observations:

1. All the four brushes were satisfactory and their length was found within limit (about 90%).
2. No pitting observed at the commutator and armature.
3. Physical condition of Armature and commutator found Satisfactory.
4. Both the bearings and bearing housing are intact and found Satisfactory.

Motor was satisfactory, stiffness observed was due to loss of lubrication of bearings due to external burning.

FLAP MOTOR ASSY.:

A) External Observations:

Flap motor assy. Was found intact, no external physical damage was found, signs of external burning observed, identification plate was found burnt, insulation of electrical leads found burnt.

Insulation and continuity check was carried out on the leads and shorting was observed as all the leads were found shorting to the body and among themselves because of burnt insulation.

Motor separated from gear assy. and observed stiff to rotate.

B) Strip Examination:

Motor was stripped and following was the observations:

1. All the four brushes were Satisfactory and their length was within limit (about 75%).
2. No pitting observed at the commutator and armature.

3. Armature and commutator found Satisfactory.
4. Both the bearings and bearing housing are intact and found Satisfactory.

Motor was Satisfactory; stiffness observed was due to loss of lubrication of bearings due to external burning.

VENT BLOWER MOTOR:

A) External Observations:

Vent blower assy. motor was found intact, however, deformed due to impact in blower portion which prevented the rotation of blower, signs of external burning observed, identification plate was found burnt, insulation and continuity check could not be carried out because the capacitor box connection the lead found burnt externally.

B) Strip Examination:

Blower assy. separated from motor assembly. Motor was stripped and following was the observations:

All the four brushes were satisfactory and their length was within limit (about 90%).

1. No pitting observed at the commutator and armature.
2. Armature and commutator found Satisfactory.
3. Both the bearings and bearing housing are intact and found satisfactory.

1.17.7 Inspection of Ship Battery and Cabin Heater

The ship battery of following description was checked at Approved Testing Facility.

Battery P/No. - NCSPB 40060D, Mfr. – HBL Power System Ltd. Hyderabad (India), Mfr. Yr. – June 2007, S.No. – 364/04

The inspection revealed that:

- Battery voltage was 22.4volts
- The Battery got damaged due to outside fire.
- Cells showing voltage below one volt were closed to the container, therefore damaged due to fire.
- No sign of thermal run away seen.

Cabin heater visually inspected, all electrical connection found normal, however, electrically the heater could not be checked as it was smashed due to impact.

1.18 Organizational and Management Information

The management structure of the aviation organisation consists of the Bureaucrats at the top as Secretary Civil Aviation and Director Civil Aviation. Both the officers besides aviation, are assigned with task of other departments/important affairs of the state Government. One aviation advisor is practically responsible for running the organisation. The Aviation advisor does not wield authority to enforce operation quality assurance and his job remains only to translate requirements into action by all possible means.

Punjab Government Super king Air B-200 aircraft was involved in an accident on 9.06.1994 near Kullu. The Court of Inquiry constituted to investigate the accident, among other recommendations had recommended that *"Operator should ensure that all their executives are fully familiar with the aviation requirements and procedures. The officer heading the aviation wing should have aviation background and should be given full authority and responsibility to run the aviation wing in compliance of all safety norms. He may be given the status of Additional Secretary"*. This recommendation has not been implemented in its true spirit

The aircraft was on ground for considerable period of time. The government decided to use it for the VIP operations. Accordingly, both the pilots were recruited after constituting a expert committee. PIC was recruited as Sr Pilot and Co-Pilot as Junior Pilot. However, the Records pertaining to their previous flying were not scrutinized/ retained. No training programme for the crew was chalked out. The organisation did not make operations manual and SOPS for the guidance of its personnel.

VIP flight was planned for 30th October 2008 viz. the day succeeding the accident date. Though the organisation claimed it had arranged other PIC for the VIP commitment but did not produce any documentary evidence to substantiate its claim.

1.19 **Additional information**

1.19.1 On request manufacturer provided data regarding incidents of Smoke in cockpit of a King Air 90 Series aircraft during flight. There had been 13 such occurrences and only one resulted in accident. Scrutiny indicated ventilation blower motor to be cause in many occurrences. Details obtained are placed below.

Date	Aircraft Model	Description of Occurrence
19.02.08	E90	Smoke reported in cockpit. The crew declared an emergency. The airplane landed without incident. Investigation revealed thermally damaged and seized ventilation blower motor.
26.11.07	C90GT	The Pilot reported that after taking off, the cockpit started filling-up with smoke. The pilot stated that during the climb-out he noticed that the cabin environmental temperature was getting hot and at approximately 26000 feet he noticed that the cockpit started filling with smoke. The pilot commented that he thought he saw smoke coming from the pedestal area in the cockpit. The aircraft returned and landed without incident.
16.04.07	C90B	Crew experienced smoke and an acrid odour in the cockpit that seemed to be coming from the pedestal. The vent blower was on but had low air flow from the outlets. They donned oxygen masks and performed an emergency descent. The airplane landed safely. Inspection of the vent blower found it to be very hard to turn with a large amount of carbon dust on the exterior.
27.04.06	C90A	While in cruise flight at 17,000 feet, the pilot smelled smoke. A few seconds later, flames and smoke started shooting out of the lower left windshield. The pilot turned off the windshield heat, and the flames went out, but the smoke persisted. The pilot declared an emergency with air traffic controllers, diverted, and landed the airplane safely. Examination of the airplane found scorch marks and soot on the left windshield near the terminal block The wind shield was pre modification. The root cause of the terminal block overheating, relating to the manufacturing process accordingly the manufacturing process was corrected.
27.02.04	E90	The flight crew experienced smoke in the cockpit after takeoff. They returned to the airport and landed without incident. The resistor on the radio lights potentiometer was found damaged.
25.02.04	B90	While on a flight in IMC, smoke filled the cockpit and cabin area. After landing, maintenance crews identified the source of the smoke as a circuit board that is part of the instrument lighting system.
14.06.02	C90B	It was reported that the vent blower motor seized and filled the cabin with smoke..
14.05.02	C90A	The pilot reported the cabin filled with smoke during flight at 20,000 ft. The pilot landed the aircraft. Maintenance crews found the pilot's left hand brake hose had been charred next to the blower motor and the blower motor brush cover appeared to have been over heated.
18.02.02	C90B	The pilot reported that they experienced smoke in the cabin at altitude Crew donned oxygen and instructed the passengers to do the same. The crew turned off all environmental equipment and the condition seemed to come under control. When the airplane descended to a safe altitude, the crew dumped cabin pressure and reported that the air quality improved. The pilot reported that they experienced no system failures and no circuit breakers tripped. Maintenance

		crews determined that the vent blower overheated as evident by a black streak coming from the brush area of the motor.
13.02.02	C90A	Just after lift off, the pilot experienced white smoke in the cockpit. The pilot followed the checklist for environmental system smoke or fumes. Step 3, vent blower-hi, caused the smoke to worsen. Vent blower assembly was replaced.
13.02.98	E90	Pilot noted smoke in the cockpit coming from the top of the glare shield on the co-pilot side. The pilot turned off windshield heat and within one to two seconds the inner pane of the co-pilots windshield shattered. The pilot immediately depressurized the aircraft and landed without further incident. Upon landing, the windshield was examined and the electrical contact block on the windshield was loose and cracked. The power wire was thermally damaged. The power wire screw was loose. The current limiter did not blow.
11.12.97	E90	The captain carried out the after start checks and then switched on the cabin lights. A smell of electrical burning became apparent and smoke was traced coming from the cup holder area immediately below the forward edge of the emergency exit door. The aircraft was evacuated. The aircraft trim was removed from around the emergency exit door and damaged lighting wiring was found shorting to earth. The damage had apparently been caused by the wires becoming trapped in the emergency exit hinge.
13.01.94	BE-90	The aircraft was destroyed during a ditching in international waters about 50 nautical miles south of Martigues, France. The ditching was precipitated by an in-flight fire during cruise flight. Pilot, the sole occupant, received minor injuries. Visual meteorological conditions prevailed. According to the pilot, an electrical fire started and produced smoke in the cockpit during the flight from Straubling-Wallmuhl, Germany, to the Azores, Portugal.

1.19.2 After the accident, a witness made video of the burning wreckage on the mobile. At 11: 35 hrs. the video recording was started. The film showed intense fire. This indicates that the aircraft had crashed between 11:25hrs and 11:35hrs.

1.20 Useful and Effective Investigation Techniques

NIL

2. ANALYSIS

2.1 Airworthiness of Aircraft

2.1.1 Maintenance of Aircraft

The Certificate of Airworthiness of the aircraft was current and valid. Aircraft was on ground for considerable period and last grounding was for a period of continuous five months. During this period the preservation of the aircraft was carried out by the maintenance agency. Periodicity of all scheduled maintenance task were

maintained.

As per the available records no snag was reported during the C of A inspection, during the period after the issue of C of A and date of accident. The maintenance organisation or the operator/maintenance agency did not maintain any defect register to allow analysis of the defects.

Page 49 of the QC Manual of Delhi Flying club requires that *all defects observed during pre flight, in flight and post flight periods shall be entered in the defect reporting and rectification register of the particular aircraft. Even if no defects are observed a Nil report shall be entered in the register. Non-compliance of the requirement shall render the aircraft un airworthy until the register is made up-to-date.* The action of the maintenance agency was in violation of the procedure specified in the QC manual.

AME is holding A&C Licence and was granted approval by Delhi Flying Club to carry out and certify daily inspection/ preflight/ transit/ post flight inspection of King Air C-90 aircraft fitted with P&W PT-6A-21 Engine, provided no defect is reported on the aircraft. As part of training he associated with work in progress of C of A renewal and carried out 7 transit inspections at Chandigarh on 09.10.2008 under the supervision of Quality Control Manager, M/s Delhi Flying Club, the Maintenance Agency.

CAR Section 2, Series 'F', Part VIII, Para 7.2.1 requires that for aircraft with an MTOW up to 5700 kg *Transit and up to Lay-over inspection without defect rectification may be carried out by BAMEL/Pilot, having 10 days practical training on relevant inspections plus 7 transit inspection schedules carried out under the supervision of an appropriately qualified AME/ certification authorisation holder employed by the approved organisation plus passed a skill test conducted by the organisation's Quality Manager.*

Though the AME was associated with the C of A inspection to give him practical experience, however all the 7 transit inspection were carried out on the same day with the aim of meeting the statutory requirements and not keeping in with the spirit of the regulation. Further no skill test was carried out before permitting him to exercise the privilege of his approval. The aircraft was based at Chandigarh and maintenance agency is based in Delhi. Copies of Tech. Log for 08.10.08 & 09.10.08

dates were available wherein no snag was indicated. Aircraft had flown for almost ten hours after the issue of the approval. Thus it is probable that if there was any snag either it was not detected or not reported. Reporting of the snag would have resulted in the grounding of the machine.

2.1.2 **Serviceability of Engine and Propeller**

The left propeller had separated from the engine at the point of first impact. Its blades were struck in the fine pitch position. The right propeller hit the long bushes at the height of around 10.5 feet simultaneously. The aircraft finally rested at a place thirty feet away from the point of first impact. After the first impact the aircraft turned by almost 270 degree and impacted the ground in nose pitch down condition. A large portion of the aircraft was consumed in the fire. At the point of first impact no marks of fire were observed neither any burnt aircraft part was located in the flight path before the final resting place of the aircraft or at far away distance from the final wreckage. Thus, after the second impact the aircraft caught fire and a large portion of aircraft got burnt/ melted/ fused. Also there was no bursting of fuel tanks.

Examination of the propeller blade damage indicated of low power. Therefore to ascertain the serviceability of the engines and to ascertain the power at the time of the impact both the engines were examined in association with the representative of engine manufacturer M/s P&W. The tear down inspection indicated that engine was producing. medium to high power at the time of impact and there was no mechanical failure or engine fire. Thus engine failure was not the source of the fire and engines were serviceable at the time of impact. To further confirm the engine power and ascertain as to why the left propeller blades were struck in the fine pitch position, tear down inspection of both the propellers and hub assemblies was carried out in association with the approved overhaul agency for the type of propellers. Examination did not indicate any abnormality. The strip examination of left propeller hub revealed that lower face of piston was resting on No.3 blade counter weight on account of which the piston did not move on to bottom of the cylinder resulting in all the three blades remaining in fine pitch position. Thus it establishes that the engines were producing medium to high power

The part of failed shaft was subjected to metallurgical examination to ascertain any

material failure or defect, pre existing crack. Metallurgical examination did not indicate of any material failure or pre-existing crack. The report indicated the mode of failure to be bending which was due to attitude of the aircraft at time of impact.

2.1.3 **Smoke in the Cockpit**

Pathological examination of the dead bodies of the crew indicated ingestion of smoke. The dead bodies were in pugilistic attitude. The views of DMS (CA) were obtained on the pathological report. As per the views tendered, there was possibility of smoke in the cockpit before the impact. Skull of both the pilots above the lower jaw had separated. This is at the level of the windscreen windows. Apparently, during the final impact the aircraft impacted the ground in steep nose down attitude. This is indicated by the telescopic effect seen in the fuselage and twisting of the leading edges of the wing and the fact that engines were recovered in the direction opposite to the direction of motion.

Examination of external filament type lights indicated that they were not supplied with the electrical power at the time of impact. The aircraft failed to respond to RT calls given by the ATC Ludhiana. Neither any RT call was made by the aircraft after commencing the right turn. It indicated that there may have been smoke in he cockpit. Thought no sign of in flight fire were observed during the examination of the wreckage.

To establish the cause of the smoke inspection of electrical system was carried out. Battery was checked at the approved maintenance facility. The inspection did not reveal any abnormality like thermal runaway or deep discharge. The battery was still having the charge. This indicated that emergency source of power was available at the time of the crash.

Due to impact and fire fuselage was completely destroyed therefore electrical circuitry of the aircraft/fuses or other electrical items which can be source of arcing/smoke could not be examined. The available electrical harness was found to be burnt due to external fire however no sign of short circuiting/arcing were observed. The data obtained from the manufacturer regarding incidents of smoke in the cockpit indicated vent blower motor to be cause of the cockpit smoke in many cases. Therefore tear down inspection of Landing gear motor, flap motor, vent blower motor assembly was carried out. No significant deficiency / abnormality

was observed in any of the three motors which could have led to their malfunction, arcing or source of smoke. Therefore source of smoke could not be ascertained. Though there exists possibility of smoke in the cockpit before the impact.

2.1.4 As per CAR Section 2 Series F Part V, *the Certificate of Airworthiness of an aircraft shall be deemed to be suspended when an aircraft ceases or fails to conform with condition stipulated in the Type Certificate or C of A, airworthiness requirements in respect of operation, maintenance, modification, repair, replacement, overhaul, process or inspection applicable to that aircraft, or*

2.1 is modified or repaired otherwise than in accordance with approved procedure, or

2.2 suffers major/substantial damage (which requires replacement or extensive repair of any major component), or

2.3 develop a major defect which would affect the safety of the aircraft or its occupants in subsequent flights.

The aircraft was maintained as per the approved maintenance programme. No snag was reported before the accidental flight. The snag of smoke appeared during the flight.

Thus it can be safely concluded that the aircraft was in airworthy condition to undertake the flight.

2.2 Competence of the crew to handle Emergency

2.2.1 Crew Qualification and proficiency

2.2.1.1 King Air C-90 was not endorsed on FAA license of co pilot. His airman file was obtained from FAA. The records from FAA did not indicate any endorsement on King Air C-90. His FAA license and records indicated endorsement on B 1900D aircraft as SIC (second in command) with limitations of day VFR operations. On the basis of his FAA license he was issued FATA for B1900D aircraft. After a skill check he flew this aircraft for M/s Ran Air. His Indian License was renewed on the basis of skill check on Cessna 152A aircraft. King Air G90 was endorsed on his Indian License on the basis of the declaration of M/s Ran Air that he had 100 hrs experiences on type and after undergoing a skill check on aircraft of later

version of type with slightly different aircraft system than the aircraft of the Punjab Government. M/s Ran Air could not produce any evidence to support the claimed 100 hrs flying experience on King Air C-90. Their declaration was based on the CA39, which did not individually mention the flying experience on King Air C-90. Thus M/s Ran Air did not exercise due diligences in verifying and submitting the flying experience to DGCA for the endorsement of the aircraft type. There was no verification to this effect in the DGCA. The fact that the FAA licence does not mention on its license all the endorsed aircraft below 5700kg and submission furnished by M/s Ran Air influenced the decision to endorse his Indian license with King Air C-90 aircraft.

His performance during the skill checks was found to be satisfactory. However, he had less experience on this type of aircraft and mostly had flown 1900D aircraft with entirely different cockpit.

2.2.1.2 The Pilot in Command held Indian ATPL and open rating on all aircraft types below 5700 kgs.

CAR Section 7, Series 'H' Part I, Para 3 states that *pilots, when regularly flying on a foreign licence, can have their Indian license, if expired, renewed and endorsed on the type presently flying provided they have Class I Medical, pass Air Regulation Test (oral) in the DGCA, carry out IR/LR checks on the simulator, of the aircraft type, under observation of FOI/DGCA nominated Examiner provider such type of aircraft is registered in India.*

His Indian ATPL was renewed without undergoing IR/LR check under observation of FOI/DGCA nominated Examiner.

Further *AIC No. 3 of 1985 requires that a pilot holding an open rating shall not excercise the privileges of that rating on any aircraft not flown by him, unless he carried out familiarisation flights with the Flight Instructor or an experienced pilot duly authorised to do so on that type of aircraft….*

Punjab Government submitted that the he had undergone familiarisation flight with Capt. Nanda, Executive pilot, Haryana Government. However Capt. Nanda denied carrying out familiarisation flight for him. He had only eight hours of experience on type.

Thus both the crew lacked qualification and familiarity with the type of aircraft.

2.2.2 **Weather induced complexity**

Under Visual Metrological conditions the required visibility is 5000m and distance from cloud minima are 1500 m horizontally 300 m (1 000 ft) vertically. Under Special VFR, a VFR flight is cleared by air traffic control to operate within a control zone in meteorological conditions below VMC i.e. Visibility of 1500 m

On the day of accident, the visibility was 1500 m. Ludhiana is an industrial town. There are many smoke emitting industrial units that add to the haze and further reduce the visibility. Due to poor visibility during the approach, the crew could not site the airfield early. At 11:17hrs it commenced right hand turn after crossing abeam thresh hold R/W 12 on east of R/W 12 and subsequently requested for R/w in use. At 11:19 hrs while it was in right hand turn, it reported overhead this time. Thereafter at 11:22 hrs. it reported 2 miles from the R/w but the runway was still not sited. At 11:23hrs. aircraft reported over the field and informed that it will make a circle to land on R/W 12. Thus the visibility conditions were much below the minima causing crew to lose the ground references.

2.2.3 **Non Adherence to standard Procedures**

Although no approach and missed approach/Go around procedure has been established for Ludhiana. However safe procedure followed by the aircraft operating to Ludhiana is *Visual Circuit, come overhead, thereafter join downwind for either 12/30 to carryout circuit at 2300 feet. Descent down to 1800 feet (1000ft agl) on base leg, if on turn to final runway is not visible, do not descend, come overhead and climb again to circuit altitude of 2300 feet. The height distance profile is 900feet agl at 3nm.*

The Go around procedure is *Climb straight ahead to 1000 feet agl, come overhead the airfield for runway change or join left down wind for Runway 12.*

Probably due to poor visibility and lack of familiarity with the terrain, the crew did not follow the standard approach procedure. After crossing abeam the threshold R/W 12 it commenced right hand turn. At less than two mile R/W 12 it made circle to align with the R/w 12 for landing. Due to non standard approach technique the

aircraft was not stabilized during the approach. The crew reported that they were little too high and went around. During the go around again the proper procedure was not followed. Crew did not use the required length of the Runway and commenced right hand turn after consuming only 400 ft of the Runway. Further in the base leg aircraft was descending or losing height in orbits, in the vicinity of the airfield rather than following standard procedures.

2.2.4 **Smoke in the Cockpit**

Pathological examination of the dead bodies of the crew indicated ingestion of smoke. The dead bodies were in pugilistic attitude. This indicated possibility of smoke in the cockpit before the impact. As per the flight manual the Action for Electrical Smoke or Fire are:

Crew –Don Masks
Cabin temp Mode- Off
Vent Blower- AUTO
Avionics Master –Off
Nonessential Electrical Equipment-Off

Examination of external filament type light viz. wing tip lights, anticollision light under fuselage indicated that they were not electrically supplied. Vent Blower was selected in auto position, while position of other switches could not be ascertained. It appears electrical lights were selected off. When the vent blower switch is in AUTO position, vent blower will operate at low speed if the cabin TEMP MODE selector switch is in any position other than OFF. When the Vent Blower s/w is in the AUTO position and the CABIN TEMP MODE selector s/w is in the OFF, the blower will not operate.

It indicates that there may have been smoke in the cockpit. The crew did not communicate of this emergency to the ATC. Though the crew are trained and assessed to handle this emergency, however If this emergency existed it added to the task of the crew and put stress on them and affected their ability to safely conduct the flight considering their qualification and experience on type of Aircraft.

2.2.5 **Obstructions in the Flight Path**

On the west side of the R/W 12, almost 900 ft. before the accident site there are two

communication towers 40 m. in height and in line with the accident site and also at same latitude as the threshold of R/W 12. These towers besides other obstructions have not been indicated in the obstruction chart of the aerodrome**.** No Obstruction Limitation Surfaces survey has been conducted since 1999. In the interest of safety of aviation, obstacle check survey should be conducted every year and all the obstruction charts should be updated and disseminated accordingly.

As per the eye witness account positioned close to these communication towers, the aircraft made three orbits in this area. During the first orbit the aircraft was high, during the second orbit the aircraft had descended and flew over these two towers and during the third orbit it flew left of both the towers and at almost the same height as these towers. Probably to avoid these towers crew made steep left bank. There after the aircraft impacted the ground in steep left bank.

2.2.6 As seen from the above the crew experience for the type of the aircraft was less. The crew lacked the familiarity with the terrain. Under the prevailing low visibility conditions the crew located the runway late. They were estimating their position based on GPS. Though they did spot the runway at some stage of the approach, they lost sight of it again and were unable to locate it subsequently. They carried out orbits on the right side (East Side) of R/w 12 in effort to visually locate the runway and then followed non standard procedure to land. Not comfortable with the approach the crew decided to go around. Due to low visibility they probably did not want to loose the sight of the airfield and therefore carried out non standard go around. In their anxiety not to lose the sight of the field they descended in three orbits in the vicinity of the airfield on the west side of R/w 12, perhaps to land after making the short circuit from the left. However the smoke in the cockpit diverted their attention and led to loss of instrument display due crew action. On sighting the communication tower, the panic gripped the crew and in their anxiety the control was lost and aircraft impacted the ground in the steep left bank.

Another scenario is that the crew got disoriented due to poor visibility and lack of familiarity with the terrain and were handicapped by low experience on type of aircraft. This would have got aggravated if they were not flying with reference to cockpit flight instruments, since they may have been looking outside to visually locate the runway. Severe disorientation could have resulted, and on seeing the communication towers panic gripped the crew leading to loss of control and

subsequent crash. Such a situation can happen when the pilot's physical conditions will not permit him to concentrate on his instruments, when the pilot is not proficient in flying instruments conditions in the airplane he is flying, or when the pilot's workload of flying by reference to his instruments is compounded by other factors. Even an instrument rated pilot encountering IFR conditions, intentional or unintentional, should, ask himself whether or not he is sufficiently alert and proficient in the airplane he is flying, to fly under such conditions. In other words a pilot encountering low visibility conditions, turbulence should decide whether to continue or turn back.

2.3 **Management Failure**

The management structure of the aviation organisation consists of the Bureaucrats at the top as Secretary Civil Aviation and Director Civil Aviation. Both the officers besides aviation are assigned with task of other departments/important affairs of the state Government. As such they are less available to understand the intricacies of the aviation and enforce the regulation and quality assurance. The Aviation advisor does not wield authority to enforce operation quality assurance and his job remains only to translate requirements into action by all possible means.

No proper check of the flying record of the crew was made at the time of the recruitment to ensure their compliance with the requirements. No training programme for the crew was chalked out. Crew never prepared load and trim sheet in violation of CAR Section 2, Series 'X', Part II which requires all operators including State Government to prepare load and trim sheet before each flight. The PIC was assigned flying duties without his undergoing the familiarization flight in violation of requirements under AIC 3 of 1985. Despite the low experience of the crew it permitted them to fly to Ludhiana under low visibility condition so that the IR check of the PIC could be carried out and they can be deployed for the VIP flight at the earliest. VIP flight was planned for 30th October 2008 viz. the day succeeding the accident date. Though the organisation claimed it had arranged other PIC for the VIP commitment but did not produce any documentary evidence to substantiate its claim. The organisation did not make operations manual and SOPS for the guidance of its personnel.

Its eagerness to ensure the use of the aircraft for the VIP overpowered the sense of safety in terms of the violations mentioned above. This was a result of lack of supervision and controls which only active organisation structure can enforce.

2.4 **Coordination between ATS Units**

Ludhiana Aerodrome is VFR Aerodrome owned by AAI. Only Aerodrome Control Services are provided at the aerodromes. SU Barnala is monitoring station and Chandigarh is ATS units controlling the traffic in that area.

Normally the aircraft coming from Chandigarh to Ludhiana descend in coordination with Chandigarh. There is no standard procedure for transfer of control from Chandigarh or SU Barnala to release the aircraft to Ludhiana. The jurisdiction of control of Ludhiana is 3000 ft. And no approach control service is available. The aircraft are being released at higher levels though jurisdiction of control of Ludhiana is 3000 ft.

The VT-EHY departed Chandigarh at 11:00 hrs.. It was cleared 6000 ft on QNH 1012 HPA on route – W36 – IBANA- direct Ludhiana. The aircraft was picked up by RADAR SU Barnala at 21 miles from Chandigarh heading 300. As per SU Barnala the aircraft identification was not available initially as it did not made R/T contact. The identification of aircraft was checked via an IAF aircraft flying from Chandigarh to Pathankot. VT-EHY was then asked to change over to Ludhiana by SU Barnala and to descend in coordination with Ludhiana. It is evident from the tape transcript that VHY did not contact SU Barnala nor ATC Chandigarh ever advice VHY to contact SU Barnala or passed traffic information to SU Barnala.

Therefore, it is clear that no procedure exist between nearby Airforce ATS units and Ludhiana ATC. For providing air traffic services and transfer of control among the ATS units a standard operating/coordination procedure need to be develop between Ludhiana and neighbouring ATS units for the aircraft approaching and landing at Ludhiana.

2.5 Permission for Special VFR

Special VFR (SVFR) flight is a flight cleared by ATC to operate within control zone in Met conditions below Visual Meteorological Conditions (VMC).

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As per AIP-India, *when traffic conditions permit, special VFR flights may be authorised subject to the approval from the unit providing approach control service and –*

- *Requests for such authorisations shall be handled individually.*
- *Separation shall be affected between all special VFR flights and between such flights and IFR flights in accordance with the separation minima applicable for IFR flights.*
- *When the ground visibility is not less than 1500 meters, special VFR flights may be authorised to enter a control zone, or to operate locally within a control zone.*

Special VFR flights shall be operated only by Pilot:

- *Holding Instrument Rating, Assistant Flight Instructor Rating or Flight Instructor Rating.*

The PIC shall ensure compliance with the provision of the rating requirements.

VT-EHY was operating as VFR flight as Ludhiana is a VFR Aerodrome. When the aircraft came in contact with Ludhiana ATC, the Controller at Ludhiana did not approve Special VFR. But PIC told the Controller that SU Barnala had cleared them for Ludhiana. Tape transcript of SU Barnala revealed that they only advised the aircraft to descend in coordination with Ludhiana. It is apparent that neither SU Barnala nor Chandigarh had authorised the aircraft for Special VFR. The advice given by SU Barnala as to descent in coordination with Ludhiana was wrongfully conveyed by crew to Ludhiana as direct clearance for landing at Ludhiana. The Tower Controller misunderstood the communication and took it as a clearance for special VFR and accordingly issued clearance to the aircraft for Ludhiana. However as per the above quoted provision of AIP neither SU Barnala nor TWR Ludhiana can authorised special VFR. AAI should ensure strict compliance of the above provisions of AIP regarding Special VFR. Thus flight was to be conducted under VFR whereas weather conditions were much below the VFR requirements.

2.6 Sequence of Events

On 29.10.08 Punjab Government Aircraft VT-EHY was to operate a flight from Chandigarh to Ludhiana for picking up Instructor Examiner on type to carry out instrument rating check of Pilot In Command. The flight plan was filed for the sectors CHG-IBANA-VILD, VILD-IBANA-CHG-IBANA-VILD, VILD-IBANA-CHG and the met briefing was obtained.

The aircraft got airborne from Chandigarh at 11:00 hrs. . It was cleared to 6000 ft on QNH 1012 HPA. At 11:10:31 hrs. aircraft turned left for Ludhiana. At 11:15:30 IST it flew abeam R/w 30 towards R/W12. At 1116 hrs. aircraft came in contact with Ludhiana ATC and informed that they were eight miles and at 7000 ft to 6000 ft and requested descent clearance. At 11:17 hrs. it commenced right hand turn on East side of R/W 12 after crossing abeam thresh hold R/W 12 and subsequently requested for R/w in use. At 11:19 hrs. while it was in right hand turn it reported overhead this time. Thereafter at 11:22 hrs, it reported 2 miles from the R/w while it still had not sited the R/W. This estimate was probably given on the basis of GPS. At 11:23 hrs. aircraft reported over the field and informed that it will make a circle to land on R/W 12.

The reported visibility was 1500 m., QNH 1013 HPA. The aircraft was cleared for landing on R/W 12 under special VFR conditions. At 11:25 hrs aircraft reported that "We are little too high … we will be coming around". This was the last communication of the aircraft with the Ludhiana ATC. The aircraft flew approximately 400 m over the R/W 12 and then commenced right hand circuit while flying over tall trees of height approximately 100 ft. on the airport boundary. The aircraft made three orbits in west side of R/w 12 for losing height. During the first orbit the aircraft was high, during the second orbit the aircraft had descended and flew over two communication towers 40m. height, in that area. During the third orbit it flew left of both the towers in steep left bank and at almost the same height as these towers possibly to avoid hitting them. The landing gears were down and locked and flaps were retracted as seen from the examination of the wreckage. The extended landing gears aided in stall due increased drag. Subsequently, in unstabilised mode and in steep left bank it impacted the ground at 900ft distance from these communication towers and in line with them. After the first impact the left propeller assembly separated from

the engine. One of its propeller blade got buried in the ground indicating that aircraft during the steep left turn was side slipping to the left and stalled. This is further supported by the damage on the left wing tip and grazing marks due to vegetation and failure mode of left propeller shaft.

Due to asymmetry in power aircraft turned by almost 270 degrees in the left direction and its further turning was stopped by a tree which impacted its tail portion. Finally aircraft impacted the ground in steep nose down attitude at 30 feet distance from the point of first impact. Three minutes later after the last contact, at 11:28 hrs. Ludhiana ATC gave a call to VHY for position but there was no reply. The fire started few minutes after the impact. The aircraft had crashed between 11:25 hrs. and 11:35 hrs. as per the time recorded in the video. Due to lack of evidences exact time of accident could not be determined. The crew died after the second impact due to fire burn and collapsing aircraft structure. Aircraft was completely destroyed due to impact and post impact fire.

ATC Ludhiana contacted other ATS units in that area for the information about the aircraft. At 11:45 hrs. it received information that aircraft had crashed at village Jugiana.

The airport fire services and city fire services were alerted. Approach to the crash site was difficult for fire services as they had to move through narrow lanes. Also airport fire services had to cross railway line running parallel to the airport which was closed during that period. After the fire was extinguished by fire services the dead bodies were recovered and transferred to hospital by District Authorities.

3. CONCLUSIONS

Findings:

3.1.1 Aircraft was airworthy at the time of commencement of the flight.

3.1.2 Organisation did not maintain defect register. This raises the doubt that whether the aircraft was having the defects which were not revealed by the organisation.

3.1.3 AME is holding A&C Licence and was granted PT-6A-21 Engine, provided no defect is reported on the aircraft. However, procedure for granting

approvals is not reflected in the QC manual. As part of training he associated with and carried out all the required 7 transit inspections at Chandigarh on 09.10.2008 and no assessment approval by Delhi Flying Club to carry out and certify daily inspection/ pre flight/ transit/ post flight inspection of King Air C-90 aircraft fitted with P&W test was carried on him before releasing him to undertake the task independently. This is not in line with the spirit of the regulation.

3.1.4 Records regarding updating of GPS Data did not exit. The crew was estimating their position based on GPS.

3.1.5 King Air C-90 aircraft was endorsed on the Indian license of the Co pilot on the basis of the wrong declaration furnished by M/s RAN Air as to his flying experience.

3.1.6 PIC was holding open rating for all type of aircraft having AUW not exceeding 5700 kgs. However as per AIC 3 of 1985 he was to undergo familiarization flights with the Flight Instructor or an experienced pilot duly authorised to do so, on that type of aircraft before he exercises the privileges of his rating. However no such familiarization flight was carried out for him.

3.1.7 Both the crew lacked qualification and familiarity with the type of aircraft.

3.1.8 Crew never prepared load and trim sheet during the operation of VT-EHY in violation of CAR Section 2 Series X part II.

3.1.9 Weather was a factor in as much as the visibility was poor and was not suitable for VFR operation.

3.1.10 Crew did not adhere to standard procedures for approach and landing, go around and descend subsequent to carrying out go around.

3.1.11 There was smoke in the cockpit during the final phases as evident from the pathological report and lack of electric supply during final phase. However source of smoke could not be established.

3.1.12 Obstruction chart was not revised to include the all the obstructions in the area.

3.1.13 On sighting the communication tower, the panic gripped the crew and in their anxiety the control was lost and aircraft impacted the ground in the steep left bank 900 fts away from the communication towers and in line with them.

3.1.14 After the first impact the left propeller separated from the engine. One of the propeller blade got buried in the ground indicating that aircraft during the steep left turn was side slipping to the left. Due to asymmetry in power aircraft turned by almost 270 degrees in the left direction and finally impacted

the ground in steep nose down attitude at 30 feet distance from the point of first impact and crashed.

3.1.15 Management displayed casual attitude, lack of supervision and control; and was guided by the desire to put the aircraft in use for VIP operation at the earliest. Its eagerness to ensure the use of the aircraft for the VIP operation overpowered the sense of safety in terms of the violations which went either unnoticed or were neglected. Despite the low experience of the crew it permitted them to fly to Ludhiana under low visibility condition so that the IR check of the PIC could be carried out and they could be deployed for the VIP flights at the earliest.

3.1.16 There is no coordination procedure between the adjacent ATS units.

3.1.17 Provision of AIP regarding Special VFR was not adhered to. Neither SU Barnala nor TWR Ludhiana can authorise special VFR.

3.1.18 Due to presence of structures higher than the floor level of control tower in the vicinity in its existing position, visual surveillance of r/w 12 beginning, operational area and area in the backside of the aerodrome control tower is limited. Also from r/w 12 beginning and adjacent operational area, aerodrome beacon located at the top of control tower is not visible.

3.1.19 Rescue operations by the airport fire services was delayed due to railway line running parallel to the airport which was closed during that period.

3.2 Probable cause:

The accident occurred due to loss of control while in base leg for landing at R/W 12 after executing go around on R/W 12.

Contributory Factors:

1) Low visibility reduced the margin of safety, may have caused severe disorientation, influenced their decision and played on crew for use of non standard procedures.
2) Both the crew lacked qualification/experience and familiarity with the type of aircraft and terrain.
3) Smoke in the cockpit further reduced the margin of safety and distracted the attention of the crew.
4) Obstruction in the flight path made the crew to take severe action and led to loss of control.
5) Lack of operational control and supervision by the organisation.

4. SAFETY RECOMMENDATIONS

4.1 In all the Government Aviation Setup, the top management personnel should be dedicated only to the aviation functions so that he understands the intricacies of the aviation and ensure proper supervision and control and enforcement of safety regulations.

4.2 State government should not be permitted to commence operation unless they have proper management system, operation system, maintenance system and operations manual & SOPS in place.

4.3 Aerodrome operators/ Airport Authority of India may be advised to take appropriate action to ensure that search and rescue operation for accident taking place out side the airport boundary are not hampered due to restriction at the exit of the Airport as is the condition at Ludhiana Airport. They should also ensure adequate fire fighting gear is available for use of personnel.

4.4 Coordination procedure should be established between ATS unit at Chandigarh, Ludhiana and SU Barnala.

4.5 Licences issued by other states where type qualified aircrafts are not mentioned on the body of the licence, verification should be obtained for each type of aircraft from the state issuing the licence before proceeding to endorse that type aircraft on the applicant's Indian license.

4.6 Action as deemed fit may be taken against Ran Air in view of finding 3.1.5.

4.7 Action as deemed fit may be taken in view of findings 3.1.2, 3.1.3 &3.1.4 indicating lapses of maintenance agency and lapses of State Government as enumerated in findings3.1.6,3.1.7, 3.1.8 & 3.1.15.

4.8 Airports Authority of India should ensure strict compliance of the provisions of AIP regarding Special VFR and take appropriate action in view of finding 3.1.18.

4.9 Indian Meteorological department may be advised to establish pre-determined landmarks for observation of visibility of 5000m and more in all directions.

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(Maneesh Kumar)
Inspector of Accidents
18.08.2009