



**REPORT  
OF  
COMMITTEE OF INQUIRY**

**ACCIDENT TO PILATUS PC-12 AIRCRAFT VT-ACF OF  
M/S AIR CHARTERS SERVICES PVT. LTD. AT FARIDABAD HARYANA  
ON 25.05.11**

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## **Foreword**

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. The investigation has been carried out in accordance with Annex. 13 to the Convention on International Civil Aviation and under the Rule 74 of Aircraft Rules 1937 of India. The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this accident which may help to prevent such future accidents or incidents.

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**REPORT ON ACCIDENT TO  
M/S AIR CHARTER SERVICES PVT. LTD PILATUS PC-12/45 AIRCRAFT  
VT-ACF AT PARVATIA COLONY, FARIDABAD ON 25.05.2011**

a) Aircraft

Type and Model : Pilatus PC-12/45  
Nationality : Indian  
Registration : VT-ACF

b) Owner/Operator : M/s Air Charter Services Pvt. Ltd.

c) Date of Accident : 25<sup>th</sup> May 2011

d) Time of Accident : 22:43 IST (Approx.)

e) Last Point of Departure : Patna

f) Point of Intended Landing : Indira Gandhi International Airport, Palam, New Delhi

g) Geographical Location of Accident : Parvatis Colony, Faridabad

**Coordinates:**

N 28° 21' 37.08"

E 077° 16' 58.2"

Altitude: 704 ft.

h) Type of Operation : General Aviation

i) Phase of Operation : Approach

**(All timings in the report are in IST)**

## **SYNOPSIS**

On 25.05.2011 a Pilatus PC-12/45 aircraft, VT-ACF, owned by M/s Air Charter Services Pvt. Ltd met with a fatal accident while operating flight from Patna to New Delhi.

The accident was investigated by Committee of Inquiry appointed under Rule 74 of Aircraft Rules, 1937. As per the obligations under ICAO Annex 13, notification was sent to Aircraft Accident Investigation Board, Switzerland the State of Aircraft Manufacture and Design and Transport Safety Board (TSB), Canada, the State of engine manufacture. TSB, Canada and AAIB Switzerland appointed their accredited representatives and authorized engine manufacturer M/s Pratt & Whitney and M/s Pilatus to associate with the investigation of engine, wreckage and other aircraft components.

The aircraft VT-ACF was hired for a medical evacuation mission to pick a critically ill patient from Patna. A crew of 2 pilots and medical team comprising of 2 doctors and a male nurse got airborne from New Delhi for Patna. The flight was uneventful. The patient and one attendant were on board during the Flight back from Patna. Weather in Delhi airspace started deteriorating as the flight came closer to Delhi. Wide spread thunderstorm activity was seen North-Northeast of Delhi airport which was moving south. About 10 min before landing VT-ACF was seen on radar in a turn to the left gaining and losing height and thereafter an abrupt turn to the right in which the aircraft seemed to loose height very rapidly before the Delhi Approach Radar stopped picking up the aircraft on radar. Repeated attempts to raise the aircraft on VHF radio as well as emergency frequency 121.5 MHz failed to get any response.

After 7 min, ATC tower received information from the City Fire Brigade confirming that an aircraft had crashed near Faridabad in a congested residential area known as Parvatis Colony. The aircraft had crashed on one of the houses of the colony. Due to impact and post impact fire the aircraft was totally destroyed and all seven people on board the aircraft and three residents of the house on which it crashed were killed. After the accident, local residents of the area and police put off the fire and extricated the bodies from the wreckage of the aircraft.

## **1. Factual Information**

### **1.1 History of the Flight**

M/s Air Charter Services Pvt Ltd. offered their aircraft VT-ACF for operating medical evacuation flight to pick one critically ill patient from Patna on 25/05/2011. The Aircraft took off from Delhi to Patna with two crew members, two doctors and one male nurse. The Flight to Patna was uneventful. The Air Ambulance along with patient and one attendant took off from Patna at 20:31:58 IST, the aircraft during arrival to land at Delhi crashed near Faridabad on a Radial of 145 degree and distance of 15.2 nm at 22:42:32 IST.

Aircraft reached Patna at 18:31 IST. Flight Plan for the flight from Patna to Delhi was filed with the ATC at Patna via W45-LLK-R594 at FL260, planned ETD being 22:00 hours IST and EET of 2hours for a planned ETA at VIDP being 24:00 hours IST. The crew took self-briefing of the weather and same "Self Briefing" was recorded on the flight plan submitted at ATC Patna. The passenger manifest submitted at Patna indicated a total of 2 crew and 5

passengers inclusive of the patient. Weather at Patna at the time of departure was 3000m visibility with Haze. Total fuel on board for departure at Delhi was 1516 lts. The preflight/transit inspection of the aircraft at Patna was carried out by the crew as per laid down guidelines. The crew requested for startup at 20:21 IST from Patna ATC and reported airborne at 20:33:43 IST. The aircraft climbed and maintained FL 260 for cruise.

On handover from Varanasi Area Control (Radar), the aircraft came in contact with Delhi Area Control (East) Radar at 21:53:40 IST at 120.9 MHz. At 21:53:40 IST aircraft was identified on Radar by squawking code 3313. At 22:02:05 IST the crew requested for left deviation of 10° due to weather, the same was approved by the RSR controller. At 22:05:04 IST the crew informed that they have a critical patient on board and requested for priority landing and ambulance on arrival. The same was approved by the RSR controller. The aircraft was handed over to Approach Control on 126.35 MHz at 22:28:03 IST.

At 22:28:18 IST VT-ACF contacted TAR (Terminal Approach Radar) on 126.35 MHz and it was maintaining FL160. At 22:32:22 IST, VT-ACF was asked to continue heading to DPN (VOR) and was cleared to descend to FL110. At 22:36:34 IST, the TAR controller informed VT-ACF about weather on HDG 330°, the crew replied in “Affirmative” and requested for left heading. At 22:38:12 IST, TAR controller gave aircraft left heading 285° which was copied by the aircraft. The aircraft started turning left, passing heading 289, it climbed from FL125 to FL141. At 22:40:32 IST the TAR controller gave 3 calls to VT-ACF. At 22:40:43 IST aircraft transmitted a feeble call “Into bad weather”, at that instance the aircraft had climbed FL 146. Thereafter the aircraft was seen turning right in a very tight turn at a low radar ground speed and loosing height rapidly from FL146 to FL 016. Again at 22:41:32 IST TAR

controller gave call to VT-ACF, aircraft transmitted a feeble call "Into bad weather. Thereafter the controller gave repeated calls on both 126.35 MHz and also 121.5 MHz, before the blip on radar became static on a radial of 145 degree at 15.2 nm from DPN VOR at 22:42:32 IST. All attempts to raise contact with the aircraft failed.

The TAR controller then informed the duty WSO and also the ATC Tower. At 22:50:00 IST, the tower informed the WSO that they have got a call from the City Fire Brigade confirming that an aircraft has crashed near Faridabad in a congested residential area known as Parvatis Colony. After the accident, local residents of the area and police tried to put off the fire and extricate the bodies from the wreckage of the aircraft.

## **1.2 Injuries to Persons**

Injuries	Crew	Passengers	Others
Fatal	2	5	3
Serious	Nil	Nil	Nil
Minor/None	Nil	Nil	

## **1.3 Damage to Aircraft**

Pilatus PC-12/45 Aircraft VT-ACF was destroyed due to impact and post impact fire.

## **1.4 Other Damage**

There was extensive damage to House and property of House No. 1254 and 1253 and minor damage to House No. 1255 in the Parvatis Colony, Faridabad.

## **1.5 Personnel information**

### **1.5.1 Pilot-in-Command:**

#### **License Details:**

He did his training for the issue of the CPL at Academy of Carver Aviation Private Ltd. CPL was issued to him on 15.05.2007. He underwent endorsement training on Pilatus PC-12 aircraft while serving in M/s Air Deccan after passing DGCA Specific Examination on type on 30/11/2007. He underwent adverse weather/monsoon training and check for release as commander for operation during the adverse weather/monsoon in accordance DGCA Ops Circular 9 of 2010 on 6.07.2010.

License type	:	CPL - 5251
CPL Valid up to	:	14/05/2012
Date of Initial Issue	:	15/05/2007
Date of Endorsement	:	03/04/2008 for Pilatus PC-12
Date of Birth	:	09/03/1982
Medical Valid up to	:	22/08/2011
FRTG No, valid till	:	9616, valid till 13/07/2011
Instrument Rating No.	:	4986
Date of last IR check	:	20/05/2011
PC check	:	20/05/2011

#### **Aircraft Ratings:**

AS PIC : Pilatus PC-12, Cessna 152 A

#### **Flying Details :**

Total Flying Experience : 1521:05 Hrs

Total instrument flying	:	707:15 Hrs approx.
Actual	:	687:15 Hrs
Simulated	:	20:00 hrs
Experience on type	:	1300 Hrs approx.
Flying during Last One year	:	680 Hrs
Flying during last 6 months	:	405 Hrs
Flying during Last 30 days	:	50 Hrs
Flying during last 7 days	:	8:30 Hrs.
During last 24 hours	:	2:00 hrs

He was not involved in any Accidents or Serious Incidents previously.

#### **1.5.2.1 Co-Pilot:**

He had undergone pilot training at Wings Flight Training, New Zealand. He had undergone simulator training at Simcom, Orlando, USA and also flight training for type rating on Pilatus PC-12. He was employed by M/s Air Charter Services Pvt Ltd subsequently.

#### **License Details:**

License type	:	CPL 7312
CPL Valid up to	:	22/12/2013
Date of Initial Issue	:	23/12/2008
Date of Endorsement	:	25/03/2011 for Pilatus PC-12
Date of Birth	:	26/07/1989
Medical valid up to	:	26/04/2012
Instrument Rating No.	:	7004
Details of last two	:	P-68 C on 16/10/2008
IR check	:	Pilatus PC-12 on 13/02/2011

PC check : 13/05/2011

**Aircraft Ratings:**

AS PIC : Pilatus PC-12, P-68 C

**Flying Details :**

Total Flying Experience : 300:04 Hrs 320

Experience on type : 70 hrs

Flying during Last One year : 36 hrs

Flying during Last 30 days : 36 Hrs

Flying during last 7 days : 9:55 Hrs

During last 24 hours : 2hrs

He was not previously involved in any air accident/serious incident.

**1.5.4 Aircraft Maintenance Engineer**

The AME is holding HA & JE category license issued on 13.11.2007. Aircraft Pilatus PC-12 Series and Engine Pratt & Whitney PT6A-67B was endorsed on his license on 13.05.2010.

**1.5.5 Air Traffic Control Officers**

The ATC Officer manning area control (East) holds ratings on Tower, Area, Approach and RSR. His last Proficiency Check was carried out on 28.10.2010.

The ATC Officer manning approach holds ratings on Tower, Area, Approach and RSR. His last Proficiency Check was carried out on 27.10.2010.

## 1.6 Aircraft Information

### 1.6.1

<b>Manufacturer</b>	Pilatus Aircraft Ltd, Stans, Switzerland
<b>Type</b>	PILATUS PC-12/45
<b>Constructor's S.NO.</b>	632
<b>Year of Manufacturer</b>	2005
<b>Certificate of Airworthiness</b>	6288, Issued/revalidated on 21.01.2011, on the strength of FAA export C of A No. E437076 Valid Up to 11.05.2015
<b>Airworthiness Review Certificate</b>	Issued on 27.01.2011, valid till 26.01.2012
<b>Category</b>	Normal
<b>Sub Division</b>	Passenger
<b>Certificate of Registration</b>	4179 issued on 21.01.2011
<b>Owner</b>	M/s Air Charters Services Pvt. Ltd., D-67, Ground Floor, Defence Colony, New Delhi-110024
<b>Minimum Crew Required</b>	02
<b>Maximum All Up Weight Authorised</b>	4500
<b>Last Major Inspection</b>	100 Hrs inspection carried on 15.04.2011 TSN 1392.18 Hrs CSN 1077
<b>Last Inspection</b>	100 Hrs inspection
<b>Air frame Hrs. Since New</b>	1483.36 Hrs as on 23.05.2011
<b>Air frame Hrs. Since last C of A</b>	233.54 Hrs as on 23.05.2011
<b>Engine</b>	
<b>Manufacturer</b>	PRATT & WHITNEY
<b>Type</b>	Turbo (PT6A-67B)

<b>Serial No.</b>	PCE PR 0504
<b>Hours Done Since New</b>	1483.36Hrs
<b>TSO</b>	---
<b>Last Inspection Carried Out</b>	100 Hrs
<b>Last Major Inspection Carried out</b>	100 Hrs
<b>Average Fuel Consumption</b>	350 lbs. /hr
<b>Average Oil Consumption</b>	0.3 lbs/hr
<b>Propeller</b>	
<b>Manufacturer</b>	HARTZELL, HC-E4A-30/E10477K
<b>Sr. No.</b>	KX-152
<b>Last Overhaul</b>	21.04.2011
<b>Hours since Overhaul</b>	46:00Hrs

### 1.6.2 Scrutiny of records

- All mandatory modifications as per DGCA mandatory modification list for PC-12 type of aircraft have been complied with.
- Since the time of commencement of its operation in India, no snag on the aircraft has been reported.
- On 25.05.2011, the day of accident the aircraft had operated on Delhi-Chandigarh-Delhi and Delhi-Patna sector and no snag was reported in either of these flights.
- The Daily Inspection schedule was carried out by appropriately licensed AME and no snag was observed.

### **1.6.3 General Description of Aircraft**

The airplane is a low wing, T-tail, single engine, retractable landing gear type designed to transport passengers, cargo, or various combinations of both passengers and cargo. Construction is conventional semi-monocoque, primarily incorporating aluminum alloy, but composite structure are used in certain areas.

The complete airframe is electrically bonded to eliminate electromagnetic interference and static discharge wicks are used to reduce static charges while in flight. The fuselage consists of the engine area, nose gear assembly, cockpit, cabin, and aft fuselage. The engine area contains the power plant, and associated accessories. The engine cowling is constructed from a carbon/nomex honeycomb material while the engine mount is welded steel tubing and bolted to the firewall in four places. The firewall is titanium and protected by insulation material. A two piece windshield, two side windows, and a direct vision (DV) window provide cockpit visibility. The two piece windshield is glass while the two side windows and the DV window are stretched acrylic. All windows are of two ply laminated design. Airplane avionics are mounted under the cabin floor, running the length of the center cabin, and are accessible through quick release panels. The cabin carry-through spar attachment fittings are one piece machined aluminum. A safety net is installed aft of the rear pressure bulkhead to protect the bulkhead from damage during maintenance.

The dorsal and ventral fin fairings are Kevlar honeycomb material. The wings are of conventional construction incorporating front and rear spars, ribs, and skin. Each wing is attached to the fuselage using three titanium shear pins

and, at the aft upper fitting, one steel tension bolt. Each wing incorporates a single-piece Fowler flap of conventional construction, with three support arms and associated linkages. The wing trailing edges above the flaps are foam core covered with carbon laminate. A surface mounted deice boot is attached to the nose skin of each wing. Each wing has a main landing gear attached to the front and rear spar, with a carbon fiber/nomex honeycomb gear door attached to the leg. The wing tips are constructed of carbon fiber/honeycomb and metal strips for lightning protection. The flight control system is conventional using push-pull rods and carbon steel cables. Electric trim systems are provided for the aileron, rudder, and elevator.

Each wing trailing edge has a single piece Fowler type flap supported by three flap arms. The flaps are controlled by a selector handle located to the right of the power controls on the center console. The flaps may be set to one of the four preset positions 0 degree, 15 degree, 30 degree and 40 degree by moving the handle to the appropriate position.

The PC-12 is equipped with a stickshaker/stickpusher system that prevents the aircraft from entering an aerodynamic stall.

**The OEM, Pilatus, had been asked for a detailed report on the Stall/Spin characteristics of the PC-12/45 aircraft as seen during test conditions during aircraft certification. The OEM report is as follows:-**

### ***Stall Characteristics***

*With an operative stall protection system the approach to a stall is characterised by the activation of the aural stall warner and stick shaker, if the AOA is further increased then the stall is characterised by the activation of the stick pusher which reduces the AOA. With an operative stall protection system*

*the pusher prevents the aircraft from reaching the AOA associated with the natural aerodynamic stall.*

### ***Spin Characteristics***

*Considering the above the PC-12 was demonstrated to be spin resistant according to FAR Part 23, Amendment 42 § 23.221 (a)(2) (supplemented by FOCA CCF 91-03), the results are presented in ER 12-03-20-006 Spin Resistance. Below is an extract from the ER referring to § 23.221 (a){2}(ii) application of pro spin controls.*

*In all the conditions tested the stick pusher activated before the aerodynamic stall, at that point, simultaneously, the required pro-spin controls were applied. The resultant aircraft motion was a nose down pitch increasing progressively, associated with roll. The angle-of-attack of the wings was always maintained below the angle-of-attack of aerodynamic stall by the action of the stick pusher, even if the elevator was pulled further back during the maneuver. The airspeed was increasing throughout the maneuver and the heading change at the end of the maneuver was always less than 90 degrees. In no case did the aircraft enter a spin or exhibit a tendency to spin. At the end of the maneuver the aircraft responded always immediately and normally to the controls and the recovery from the maneuver was performed by centralising rudder and ailerons and pulling the elevator to recover from the ensuing dive. The elevator control force never exceeded the temporary control force limit of § 23.143. The maximum maneuvering load factor as stated in the AFM limitations section is 3.3g. The PC-12 does not exhibit any unusual characteristics during high rates of descent (6,000 ft/min). This condition is*

*flown to simulate an emergency descent as part of the production acceptance testing of each aircraft. During certification the aircraft was flown up to VD / MD (280 KCAS/ 0.60 Mach). Note that VMO/MMO is 240 KCAS/ 0.48 Mach). There are no rate of turn limitations as such. The maximum maneuvering load factor is 3.3 g (refer to section 2 “Limitations” of the AFM) and VMO 240 KCAS.*

*The PC-12 fleet has accumulated more than 3.5 million flying hours. 13 fatal accidents have occurred since 1998. The PC-12 has obviously positive and damped stability characteristics which fulfill FAR 23. In adverse weather conditions it is good airmanship to switch Ignition ON, Inertial Separator ON, reduce speed to the appropriate gust penetration speed and divert away from the undesirable conditions with the aid of the weather radar. The PC-12 has significant performance capability. In severe turbulence it is possible to get autopilot disconnects so the pilot may have to fly by hand which could increase pilot work load. **The Honeywell weather radar ART 2000 that was installed in the accident aircraft has a recorded MTBF of 88,920 hrs, based on more than 3 Million operating hours.***

#### **1.6.4 Weight and Balance**

The fuel on board the aircraft before Takeoff from Delhi was 1516 lts. Taking average fuel consumption and flight time from Delhi to Patna in consideration, the fuel before takeoff from Patna was 1056 lts. The patient was carried on seat No. 4 and 6. There were four other passengers and medical equipment. The aircraft center of gravity was within limits.

## **1.7 Meteorological Information**

### **1.7.1 Met Report, Patna Airport**

<b>Time</b>	<b>:</b>	<b>20:20 IST</b>
S/WIND	:	080/08 KT
Visibility	:	3000 M
Weather	:	HZ
Clouds	:	FEW 10000 FT/3000 M,
Temp.	:	32° C
Dew Point	:	25° C
QNH	:	1001 HPA 2956 INS
QFE	:	0995 HPA 2938 INS
Trend	:	No Significant

### **1.7.2 Met Report, IGI Airport, New Delhi**

<b>Time</b>	<b>:</b>	<b>20:30 IST</b>
Wind	:	RWY28 270/04 KT RWY10 280/05KT
S/WIND	:	270/05 KT
Visibility	:	3500 M
Weather	:	HZ
Clouds	:	FEW 4000 FT/1200 M, SCT 10000 FT/3000M
Temp.	:	37° C
Dew Point	:	17° C
QNH	:	1001 HPA 2959 INS
QFE	:	975 HPA 2880 INS
Trend	:	BECMU VIS 3000 M

**Special Met Report**

Time : **22:30 IST**  
Wind : RWY28 060/29 KT RWY10 060/28KT  
  
S/WIND : 040/20G30 KT  
Visibility : 2100 M  
Weather : TS  
Clouds : SCT 4000 FT/1200 M, FEWCB 4000FT/1200M,  
          SCT 10000 FT/3000M  
Temp. : 33° C  
Dew Point : 22° C  
QNH : 1003 HPA 2964 INS  
QFE : 977 HPA 2885 INS  
Trend : TEMPO VIS 1500 M TSRA

**Special Met Report**

Time : **22:51 IST**  
S/WIND : 050/20G30 KT  
  
Visibility : 1500 M  
Weather : TS  
Clouds : SCT4000 FT/1200 M,FEWCB 4000 FT/1200M,  
          SCT 10000 FT/3000M  
Temp. : 32° C  
Dew Point : 21° C  
QNH : 1004 HPA 2965 INS  
QFE : 977 HPA 2886 INS  
Trend : TEMPO VIS 0800 M TSRA

1.7.3. **Weather conditions during the period of the accident and the forecast/warnings issued from the Meteorological Office, IGI Airport.**

***The brief description of the various weather conditions observed during 2030 IST to 2330 IST as reported in the current weather (i.e. Met reports or METAR) along with trend forecast and weather warnings based upon various meteorological instruments at various RWY ends, DWR, Satellite weather data etc is as follows:-***

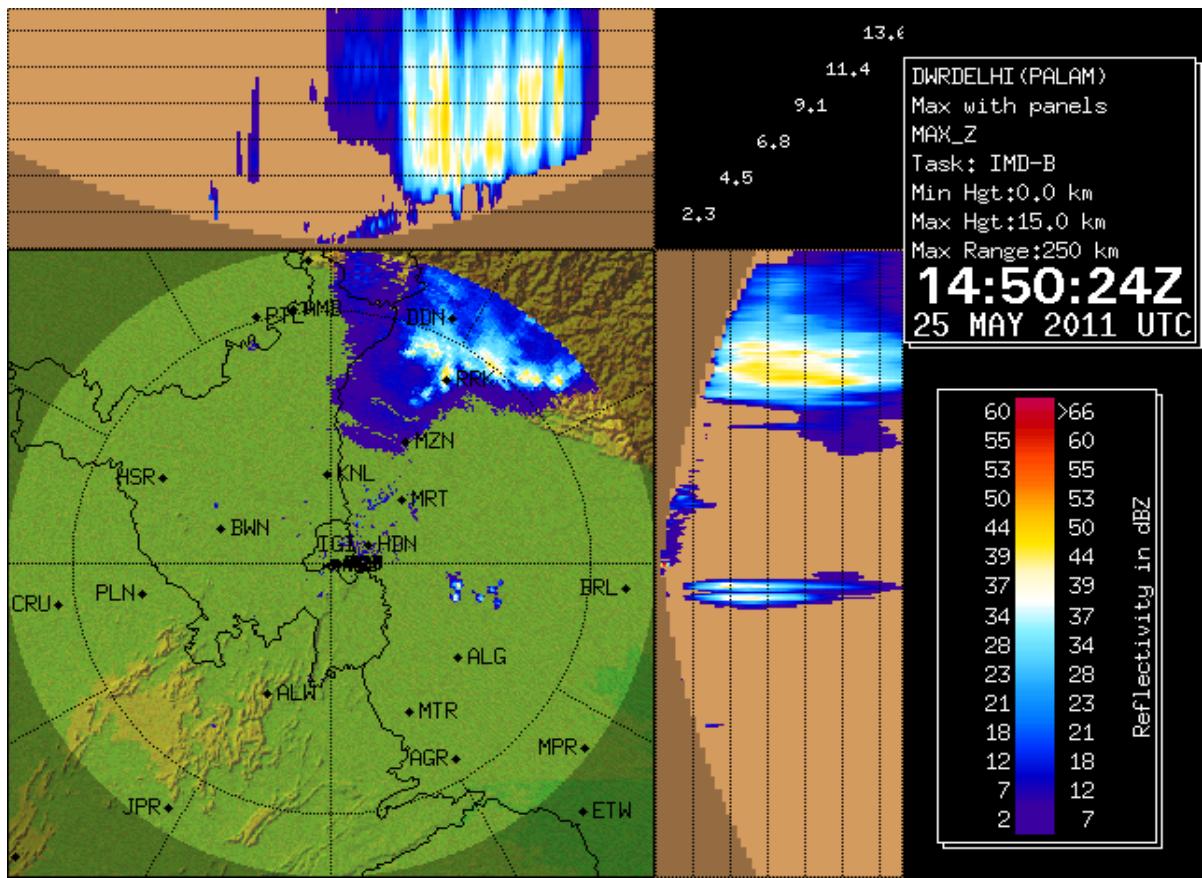
Current weather reports as issued by the Met Office for the period (decoded/simplified version of MET REPORT issued to ATC given in Table- 1) shows the airport was having visibility at 2030 IST as 3500 meter in haze with low and medium clouds of height 4000 to 10000 feet with wind 270Deg/5 Knots which deteriorated to 3000 meter at 2052 IST when CB cloud was also reported for the first time during the period (see Table 1). DWR from 2010 IST (Fig. 1) was showing movement of CB clouds to the circular domain within the 100NM of IGI due to which a weather warning for squall was issued at 2030 IST valid for 2100 to 0130 IST indicating "**IGI Airport and 100 nautical mile around is likely to be affected by Dust storm/Thunderstorm when the surface wind speed in associated squall will likely to reach from 030 deg Direction with speed exceeding 30kts/60kmph**" (Weather warnings as issued given in Annexure-A). A trend forecast of this weather warnings for ATC/PILOT was appended in the SPECI/METAR issued at 2052 IST with TEMPO 030/30KTS VIS 1500M IN TS/RA. The observations from Integrated Automatic Surface weather observing Instruments (IASWOI) confirms the weather conditions deteriorated started at 2230 IST when the RWY 27 end experienced squall/gusty winds of 31 kts/62 kmph from 040 deg which subsequently spread to various other five RWY ends. The wind speed recorded at RWY 27 ends by integrated aviation AWS have been enclosed for confirmation (Fig. 2). Accordingly a SPECIAL weather report was

**issued at 2230 IST to ATC with prevailing weather conditions as TS/DS and gusty winds of 040/20 kts gusting to 30 kts.** Due to such bad weather occurrences, the trend forecast was also continued to be appended with likely of visibility reduction to 1500 M in TS/RA. In view of gusty wind conditions continuing with visibility falling to 1500 M in TS another 2<sup>nd</sup> SPECIAL Weather report was issued to ATC at 2251 IST when surface wind was reported as 050/20kt gusting 30 kts with current weather as TS. Hereafter the weather started improving and by 2330 IST, the visibility was improved to 2500M in haze and ceased off TS.

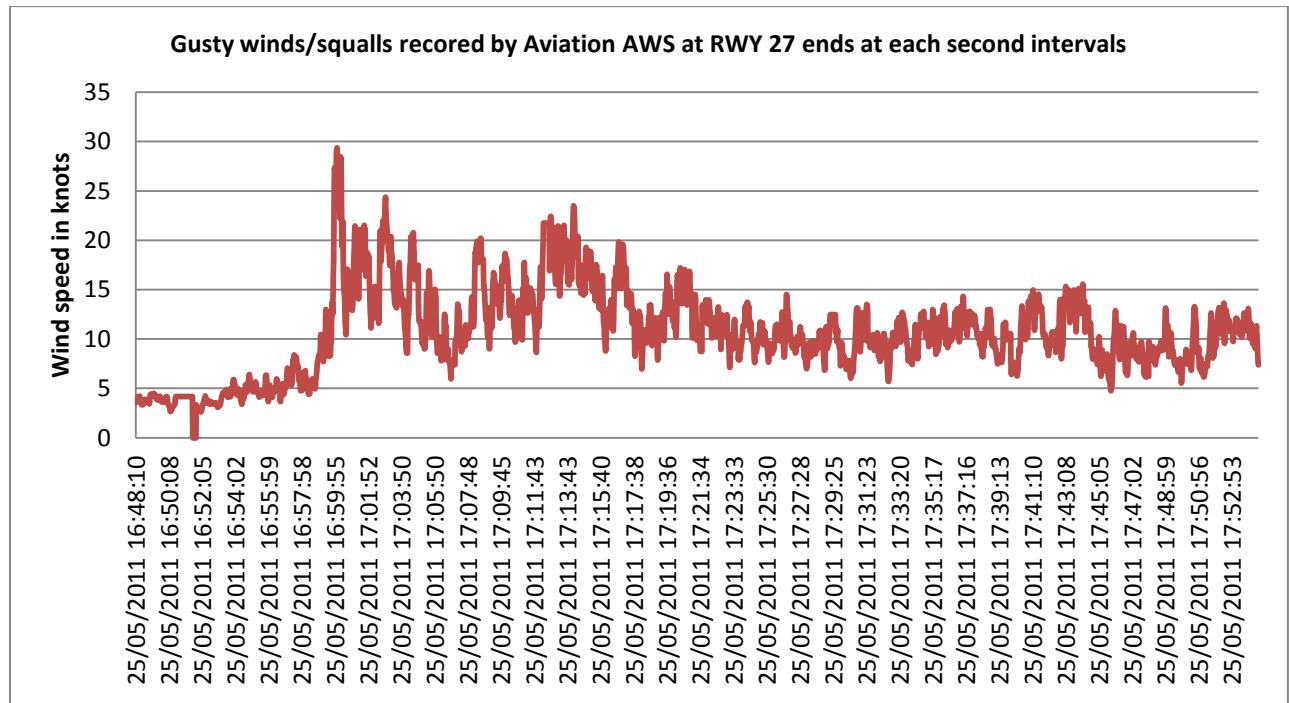
#### **1.7.4 Review of other Various Weather Warnings and Forecasts of Met**

Aerodrome forecast of IGI Airport issued at 1730 IST of 25 May valid for 2030 to 0530 IST of 25/26 May indicated likelihood of occurrences of TS/RA with wind squalls/gusty winds of 30kts from NW-290 deg and deterioration of visibility up to 1200 during 2030 to 0530 IST. Local forecast issued at 1900 IST of 25 May valid for 1930 to 0330 IST for IGI Airport and 100 nautical miles around also included likelihood of severe turbulence and moderate icing due to development of CB and likely occurrences of TS. SIGMET Warning issued during 25 May 1530 IST till 0330 IST also having warnings of CB/TS forecast in the Delhi FIR region based upon DWR and satellite observations.

**Fig. 1. DWR Cloud pictures as early as 2020 IST confirms the development of vertically grown up CB clouds at NNE to IGI Airport at 100km to 200 km circles over Uttarakhand hills based upon which IMD issues warning of DS/TS and squally/gusty weather**



**Fig. 2.**



The observations from various Integrated Automatic surface weather Instruments confirms the weather conditions deteriorated at 2230 IST when the RWY 27 end experienced squall/gusty winds of 31 kts/62 kmph from 040 deg which subsequently spread to various other five RWY ends placed as Table 1 below:-

**Table-1**

TIME IST	TYPE OF MESSAGE	VIS	PRESENT WEATHER	WIND DIRECTION	WIND SPEED	TREND FORECAST
<b>2030</b>	MEATR	3500	DUST	270	05KT	BECMG VIS 3000M
<b>2052</b>	SPECI	3000	HAZE	260	05KT	TEMPO 03030KT 1500M TSRA
<b>2130</b>	MEATR	3000	HAZE	290	04KT	TEMPO 03030KT 1500M TSRA
<b>2200</b>	MEATR	3000	HAZE	310	04KT	TEMPO 03030KT 1500M TSRA
<b>2230</b>	MEATR	2100	HAZE	040	<b>20G30KT</b>	TEMPO 1500M TSRA
<b>2251</b>	SPECI	1500	<b>DS/TS</b>	050	<b>20G30KT</b>	TEMPO 0800 TSRA

**AERODROME WARNING OF DELHI AIRPORT DATED 25-05-2011 ISSUED AT  
2100 IST TO ATC (ATC OFFICERS SIGNATURE IS THERE THAT HE RECEIVED IT  
AT 2115 IST)**

**THUNDERSTORM/DUSTORM IS LIKELY TO AFFECT VIDP AERODROME  
DURING THE PERIOD FROM 25/2100 IST TO 26/0130 IST WHEN SURFACE  
WIND SPEED IN ASSOCIATED SQUALL FROM 030 DIRECITION AND EXCEED 30  
KNOTS**

## **1.8 Aids to Navigation**

The runway in use were 10, 11. Maintenance records of Nav Aids at Delhi Airport were reviewed. There were no reported anomalies concerning the aerodrome navigation or approach aids at the time of the accident.

## **1.9 Communication**

### **1.9.1 ATC communication record of IGI Airport, Palam, New Delhi**

The aircraft was fitted with Very High Frequency (VHF) communication equipments. The aircraft was in two way communication with Area Control (East) and Terminal Approach Radar. It is evident from the Air Traffic Control (ATC) tape transcript that the aircraft had no problem on communication.

#### **1.9.1.1 Communication with Area Control**

At 21:53:40 IST aircraft VT-ACF came in contact with Area (East) at frequency 120.9 MHz. At 21:53:40 aircraft was identified on Radar by squawking code 3313. At 22:02:05 aircraft requested for 10°left deviation due weather which was approved. At 22:05:04 IST, VT-ACF intimated that there was critical patient on board and requested for priority landing and ambulance in advance. This was approved by the area control. At 22:14:53 IST Area control gave decent to FL 240 to aircraft, which was copied by the aircraft. At 22:18:20 IST area control cleared aircraft for decent to FL200. At 22:20:27 IST aircraft was cleared for decent to FL180 and to FL160 at 22:25:38 IST. Aircraft was transferred to approach Radar (Frequency 126.35 MHz) at 22:28:03 IST.

### **1.9.1.2 Communication with the Terminal Approach Radar (TAR)**

Aircraft came in contact with the Approach Radar (frequency 126.35 MHz) at 22:28:18 IST. Aircraft intimated that it was maintaining FL160 and continue to DPN. At 23:33:41 IST Approach instructed the aircraft to descend to FL110 which was copied by VT-ACF. At 22:36:34. Approach intimated the aircraft about whether on heading 330, and the crew requested for left heading. At 22:38:12 Approach gave aircraft left heading 285, which was copied by the aircraft. At 22:40:43 IST aircraft transmitted that "**Into bad weather**". Again at 22:41:32 IST aircraft transmitted "**Into bad weather**".

### **1.9.1.3 Communication with the Approach (SA) Frequency 124.2 MHz**

At 22:28:45 IST AIC011 making approach for landing at R/W 28 intimated that it was going around and requested for R/W 11. At 22:30:27 IST controller intimated winds for R/W 28 as 050 degree 29 knots. At 22:30:55, controller intimated SEJ 142 winds for 28 to be 080 degree 26 knots, and asked to confirm if it wished to continue. SEJ 142 requested for the change of the Runway. At 22:31:22 R/W was changed to R/W 11.

## **1.9.2 Communication Recording of Approach Radar**

### **1.9.3 Radar Recording**

The aircraft was painting on the approach Radar of IGI Airport, New Delhi up to 15.2 nm from it. The radar recording of Approach Radar was obtained and on its basis the position of the aircraft w.r.t VIDP was determined as given below:

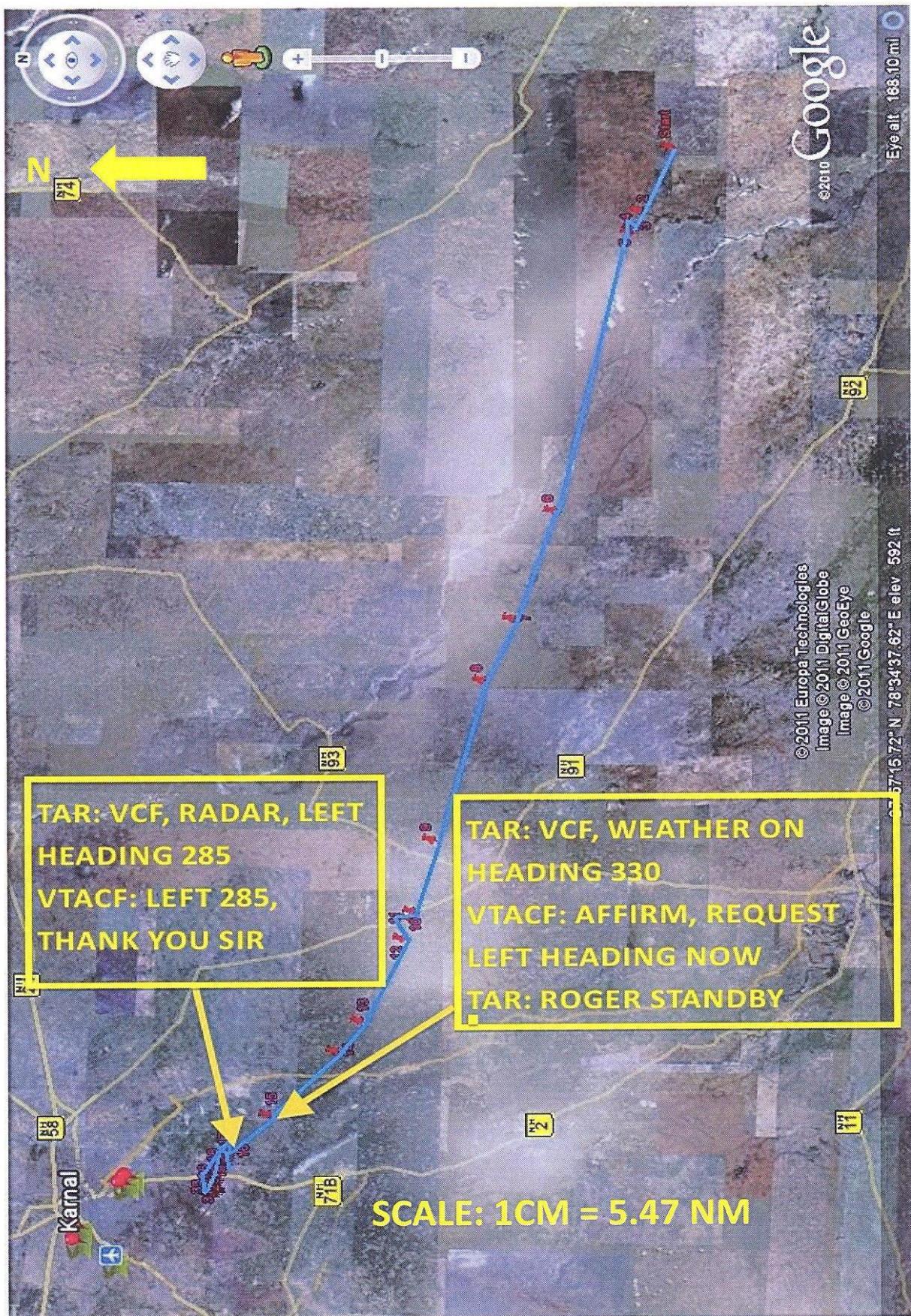
Time Stamp (IST)	Level (value x 100) feet	Grd Speed	Aprox. Heading	Latitude	Longitude	Radial from DPN VOR (Aprox.)	Distance (NM) from DPN (Approx.)
22:02:06	260	N0234	308	273350N	0794948E	111	157.3
22:04:27	260	N0231	290	273713N	0794023E	111	147.9
22:05:01	260	N0232	289	273758N	0793759E	111	146.0
22:05:06	260	N0232	289	273804N	0793738E	111	145.7
22:05:12	260	N0232	288	273811N	0793714E	111	145.4
22:14:51	260	N0232	283	274615N	0785637E	115	109.2
22:18:21	241	N0259	286	275038N	0784053E	116	94.5
22:20:26	230	N0247	290	275346N	0783152E	117	86.0
22:25:36	183	N0241	281	275856N	0780838E	121	65.9
22:28:01	161	N0238	282	280052N	0775808E	125	57.1
22:28:16	160	N0238	282	280107N	0775703E	125	56.2
22:29:01	160	N0212	284	280155N	0775409E	126	53.3
22:32:21	160	N0212	298	280619N	0774158E	130	42.2
22:33:41	160	N0214	309	280852N	0773727E	131	37.5
22:36:36	142	N0235	311	281606N	0772755E	132	26.4
22:38:12	133	N0235	303	282008N	0772215E	133	20.1
22:38:16	132	N0231	303	282017N	0772158E	133	19.8
22:38:21	132	N0229	301	282027N	0772140E	133	19.8
22:38:26	132	N0228	301	282037N	0772121E	133	19.5
22:38:31	131	N0223	297	282045N	0772103E	133	19.1
22:38:36	130	N0219	301	282054N	0772047E	134	18.9
22:38:42	130	N0218	299	282103N	0772028E	134	18.3
22:38:46	130	N0218	293	282108N	0772009E	134	18.3
22:38:51	129	N0216	290	282114N	0771951E	135	17.8
22:38:56	129	N0212	290	282120N	0771932E	135	17.8
22:39:02	128	N0211	291	282126N	0771912E	135	17.5
22:39:07	128	N0211	290	282132N	0771853E	136	17.0
22:39:12	129	N0209	289	282138N	0771835E	137	16.7
22:39:17	128	N0211	289	282143N	0771816E	137	16.5
22:39:22	128	N0208	289	282149N	0771757E	138	16.2
22:39:27	127	N0209	291	282156N	0771738E	138	15.9

Time Stamp (IST)	Level (value x 100) feet	Grd Speed	Aprox. Heading	Latitude	Longitude	Radial from DPN VOR	Distance (NM) from DPN (Approx.) (Aprox.)
22:39:32	125	N0212	287	282200N	0771718E	138	15.9
22:39:37	125	N0210	288	282206N	0771659E	139	15.4
22:39:42	128	N0205	289	282211N	0771642E	139	15.4
22:39:46	132	N0191	289	282214N	0771629E	140	15.2
22:39:52	136	N0162	293	282218N	0771619E	140	15.0
22:39:57	140	N0124	291	282217N	0771612E	141	14.9
22:40:02	141	N0116	280	282217N	0771602E	141	14.8
22:40:06	141	N0098	281	282217N	0771556E	141	14.8
22:40:11	138	N0138	235	282203N	0771546E	142	14.7
22:40:17	131	N0133	146	282147N	0771608E	142	15.2
22:40:21	133	N0198	125	282135N	0771627E	142	15.2
22:40:26	136	N0209	113	282129N	0771647E	141	15.8
22:40:31	140	N0192	107	282127N	0771702E	141	15.8
22:40:37	146	N0095	101	282134N	0771702E	141	16.0
22:40:42	145	N0041	081	282140N	0771701E	140	15.8
22:40:47	141	N0034	003	282147N	0771656E	140	15.6
22:40:52	136	N0042	325	282150N	0771652E	140	15.6
22:40:57	136	N0028	345	282151N	0771653E	140	15.6
22:41:02	136	N0022	352	282153N	0771653E	140	15.6
22:41:07	136	N0015	345	282153N	0771653E	140	15.5
22:41:12	No info	N0016	030	282154N	0771655E	140	15.5
22:41:17	No info	N0020	050	282155N	0771657E	140	15.5
22:41:22	No info	N0014	075	282154N	0771658E	140	15.6
22:41:27	No info	N0047	124	282148N	0771704E	140	15.7
22:41:32	78	N0048	129	282145N	0771708E	140	15.8
22:41:37	78	N0043	121	282144N	0771711E	140	15.8
22:41:42	62	N0030	148	282144N	0771711E	140	15.8
22:41:46	62	N0027	116	282144N	0771712E	140	15.8
22:41:51	48	N0021	149	282143N	0771712E	140	15.8
22:41:56	43	N0016	124	282143N	0771713E	140	15.8
22:42:01	43	N0015	167	282142N	0771712E	140	15.8
22:42:06	28	N0013	171	282142N	0771710E	140	15.9
22:42:11	23	N0030	233	282141N	0771706E	140	15.8

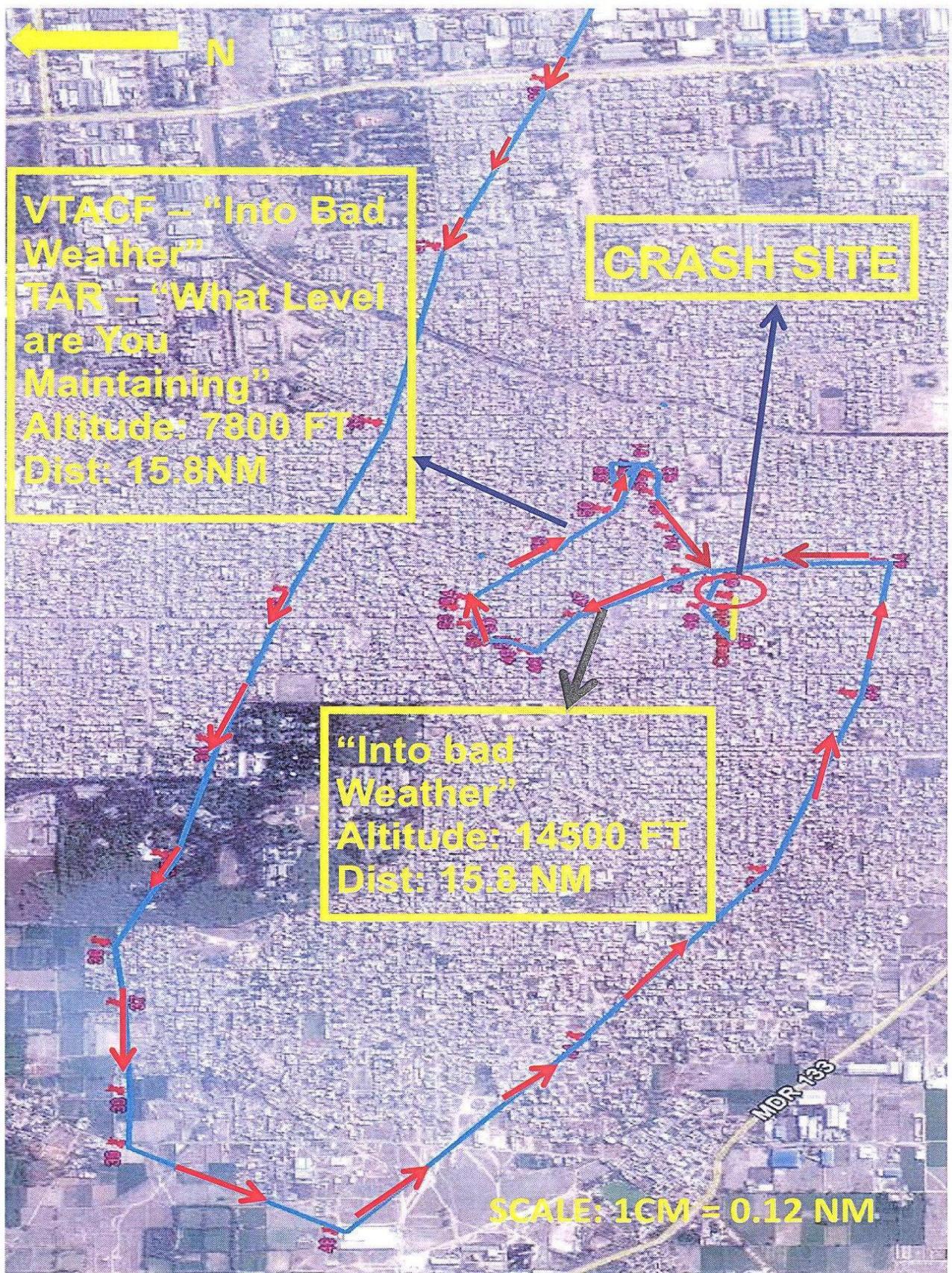
<b>Time Stamp (IST)</b>	<b>Level (value x 100) feet</b>	<b>Grd Speed</b>	<b>Aprox. Heading</b>	<b>Latitude</b>	<b>Longitude</b>	<b>Radial from DPN VOR (Aprox.)</b>	<b>Distance (NM) from DPN (Approx.)</b>
22:42:16	23	N0052	239	282138N	0771700E	140	15.8
22:42:21	16	N0044	251	282139N	0771657E	141	15.8
22:42:27	16	N0044	251	282137N	0771653E	141	15.7
22:42:32	16	N0044	251	282136N	0771648E	141	15.7
22:42:37	16	N0044	251	282135N	0771644E	141	15.7
22:42:41	16	N0044	251	282133N	0771640E	141	15.7
22:42:46	16	N0044	251	282132N	0771637E	141	15.7
22:42:51	16	N0044	251	282131N	0771632E	142	15.7

#### 1.9.4 Correlation of Radar Plot and Radio Communication

Path of VT-ACF after contacting TAR plotted on satellite image:-



Path of VT-ACF after turning left: -



## **1.10 Aerodrome information**

IGI Airport is about 21 KMs away from Delhi. The administrative authority of the airport is vested with Delhi International Airport (P) Ltd., New Delhi and Air Navigation Services is provided by National Airports Authority. The aerodrome is operational for full 24 hours. The elevation of the aerodrome reference Point is 227m. AMSL and geographical coordinates of aerodrome reference Point are 28°34'07.42" N 077°06'43.69"E. There are three runways 28/10, 27/09 and 29/11.

### **Runway Dimension and related Information:**

Runway	Elevation	True Bearing	Dimensions of RWY (M)
09	218.47m	091°15' GEO	2813x 45
27	228.75m	271°15' GEO	2813x 45
10	219.20m	104°15' GEO	3810 x 45
28	236.76m	284°15' GEO	3810 x 45
11	220.50m	103°15' GEO	4430 x 60
29	229.00m	283°15' GEO	4430 x 60

### **The Declared distances of runway are as follows:**

RWY	Intersection Department (m)	TORA (m)	TODA (m)	ASDA (m)	LDA (m)
09	E3 : 2673	2813	3246	2813	2813
27	E : 2085	2813	3513	2813	2661

					(THR displaced by 152m)
<b>10</b>	E4 : 3235  D : 2583	3810	3810	3810	3810
<b>28</b>	E : 3056  C : 3350  W : 3350	3810	4084	3810	3810
<b>11</b>	Z9 : 4110  Z8 : 4097  S5 : 3920  S4 : 3822	4110	4110	4430	3465  (THR displaced by 645m)
<b>29</b>	Z1 : 4430  CE1: 4417  CE2: 4320  Z2 : 3919	4430	4430	4430	2970  (THR displaced by 1460m)

### 1.10.2 Meteorological Services

IGI airport has Class I Met Office. It provides services on 24hrs basis. India Meteorological Department provides up-to-date information on existing and forecast of meteorological conditions i.e. Met Reports / Special reports , RVR observations, Local forecast, RAREP, Fog Forecast, Aerodrome Warnings, SIGMET etc. to Air traffic services units of Approach Control and Control tower through messenger or phone or through a PC based display. It also gets inputs from Doppler weather radar.

Detailed information to Air traffic services units on the location, vertical extent, direction and rate of movement of meteorological phenomena in the

vicinity of the aerodrome, which could be hazardous to aircraft operations, **is not-available**. However, the position of CB other cloud heights are available using radarscope and Ceilometers. Information regarding wind shear is incorporated in the current weather reports as per information received from approaching aircraft.

### **1.11 Flight Recorders**

The Aircraft was not equipped with Flight Data Recorder/ Cockpit Voice Recorder as per the existing regulations.

### **1.12 Wreckage and Impact Information**

Accident site is a densely populated residential area in district Faridabad, Haryana. The coordinates of the accident site are N 28° 21'37.08", E 077° 16'58.2". Due to impact the aircraft had broken into a number of pieces. **There was no significant spread of the wreckage.** The wreckage was mainly concentrated on House No. 1254 and House No. 1253. The aircraft approached the accident site in right bank with negative pitch attitude.

The forward motion of the aircraft was restricted as the right side of the fuselage, engine and the right wing impacted the boundary wall on the roof of the house no 1253. The main wreckage was lying on the roof top of the House No. 1254. Due to the impact of the right wing the forward facing wall of a room on the roof of the House No 1254 (between House No. 1253 and 1254) was shattered.



***Wreckage In Final Resting Position***

The remaining portion of the structure of the House No 1254 received fire damage and was covered with the smoke possibly due to bursting of the fuel tank in the right wing. Roof of House No. 1254 made of concrete collapsed at few places due to impact. All the three landing gears of the aircraft were hanging down through the collapsed roof. A large portion of the right wing was recovered from the floor level in the House No. 1254. Due to impact and fire the aircraft was destroyed. No aircraft part was recovered before the final resting place of the wreckage. No ground marks, fire/soot marks were observed before the final resting place of the wreckage.

#### **1.12.1 Fuselage**

- (a) **Cockpit:** After the impact, nose and cockpit section caught fire and was fully consumed in it. The burnt remains of the cockpit along with cable and linkages were hanging from the roof of house No. 1253.

Few of the cockpit instruments, avionics equipments were recovered in burnt condition and a portion of fully burnt crew seat was found in the centre section of the fuselage.



**Front View: Forward Portion of Fuselage hanging from the roof of  
H. No. 1253**

**Following items were recovered:**

Pilot & co-pilot seats in burnt condition, Control column of both sides in burnt condition, Engine control Linkages, burnt EIS display, burnt Pilot EADI and EHSI display, both burnt GNS 530, half burnt Avionics Equipments like AHRS, CACU computer, Stick pusher computer, Flap control warning unit, Autopilot computer and two Flap actuators, weather Radar.

**(b) Centre Section:**

Centre Section of the fuselage was fully burnt. Some portion of the centre panels was available, some portion of 05 burnt passenger seats were recovered from this section. Aluminium stretcher scoop was also recovered in fully burnt condition. Main passenger door in locked position recovered with overheat mark on the skin due to fire.

**(c) Rear Section of the Fuselage :**

Rear section of the fuselage was recovered in intact condition. Empennage was attached to it. Cargo door in locked position along with belly skin and portion of fuselage cargo section was in good condition. Tail road and ladder were recovered in its position.

**(d) Empennage Section:**

Vertical stabilizer was attached at its position. Impact damage was seen all along the leading edge. At the joining of vertical stabilizer with the leading edge of horizontal stabilizer, skin tear was observed. The rudder was attached with the vertical stabilizer and bent towards right. Portion of dorsal fin and vertical stabilizer with portion of rudder attached but bent towards right. Horizontal stabilizer was found in position and elevator was attached to it. A portion of rudder and elevator found broken after hitting a building. Left horizontal stabilizer along with elevator had impacted top of masonry structure and finally resting on it. Due to impact it had bent upward. Horizontal stabilizer actuator intact in own position but bullet fairing was damaged. Control Linkages for rudder and elevator found intact with cables attached. Elevator was found in level condition. One lead acid battery was found in good condition but the other battery was fully damaged.

**(d) Aircraft Emergency Locator Transmitter (ELT)**

ELT was found intact in its position and ELT switch was in ARM position and was transmitting.



**Rear View: Indicating damage to the Rudder**

**1.12.2. Wing Section**

- (a) Centre section of the wing up to aileron attachments on both sides fully consumed due to fire. Flap area on both sides consumed due to fire. Inboard and outboard two flap actuators of LH Flap recovered without the outer casing.
- (b) Left Wing outer Section to wing tip was severely impacted at the leading edge. Discoloration due to heat observed on skin.
- (c) Right Wing outer Section up to wing tip was severely impacted at the leading edge. Discoloration due to heat observed on skin.
- (d) Wing to wing attachment was found intact. There was no deformation of the flange or web of the spar.

### **1.12.3 Landing Gear**

- (a) Nose Landing Gear was recovered from the wreckage of fuselage hanging from the roof of house No. 1254. Shimmy Dampener and torque link were attached to upper strut. Nose wheel tyre burnt but portion of wheel hub was recovered attached to lower strut. Paint was found burnt and fuselage attachment was not recovered.
- (b) Both the Main Landing Gears were recovered in extended position. They were attached to the fuselage and hanging through the roof of house No. 1253. Both main wheel assembly tyres were burnt but brakes and hub intact in burnt condition. Actuator intact in both main landing gears.

### **1.12.4 Engines and Propeller**

The engines had separated from the aircraft with damages due to impact.

#### **1.12.4.1 Engine (S. No. PCE PR0504)**

Propeller along with engine reduction gearbox had sheared off from the engine due to high impact. All the propeller blades were bent at the tip. No significant twist was observed. Propeller governor and over speed governor were intact along with the reduction gear box.

The engine was detached along with the frame and shock mounts from the fuselage. Propeller mounting flange found attached, bolts and locking found intact; Oil lines found broken; line union found attached; oil line from reduction gear box found damaged. Fuel nozzle interconnect and transfer lines found attached; fuel manifold, purge tank and pipelines found connected.

Engine Driven Fuel Pump along with its drive gears from accessory gearbox, and fuel pump outlet filter assembly found intact with the engine. Igniters and ignition cables found attached. Portion of the accessories gear box damaged due to impact. Starter Generator attached its position in good condition but Gen.2 was detached from the Engine, FCU along with its control linkages found attached, bolts and locking found intact. Exhaust stubs were found attached with the engine but were in the bent condition.

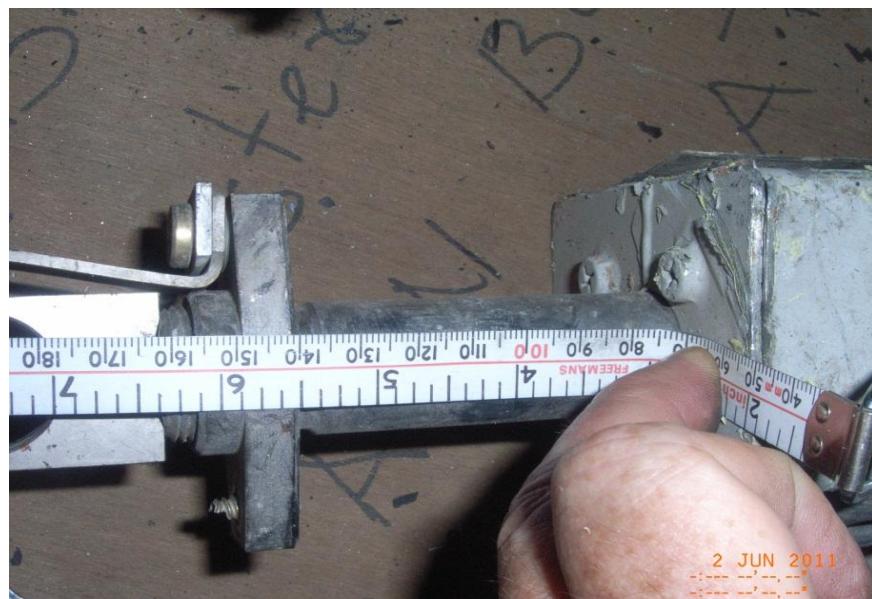
#### **1.12.5 Examination of the Wreckage in the Hangar**

The wreckage of the aircraft was relocated to Delhi Flying Club facility, at Safdarjung Airport for the purpose of post-accident examination. Examination was carried out in association with the representative from **M/s Pilatus** and following are the observations:-

##### **1.12.5.1 Trim Setting**

###### **(a) Pitch Trim Actuator**

The pitch trim actuator was found extended by 70 mm. A preliminary analysis determined this position as being within the green take-off range.



### **(b) Aileron Trim Actuator**

The aileron trim actuator was found to be extended 16 mm to the bottom of the nut. This equates to approx. neutral trim.



### **(c) Rudder Trim Actuator**

The rudder trim actuating rod was found extended by 17 mm when measured against the support strut. A preliminary assessment indicates that this equates to some aircraft nose right trim.



**1.12.5.2** Following components were sent to M/s Pilatus for testing/retrieval of data

Sr. No	Part Designation	Part No.
1.	Weather Radar ART 2000	985.99.11.503
2.	CACU	972.81.32.030
3	Fuel Filter	968.35.21.001
4	GNS 530	011-00550-10
5	IHAS KMH 820	985.99.11.872
6	EIS	975.29.02.017
7	ODM Sensor	975.21.15.204/241

### **1.13 Medical and Pathological Information**

The postmortem examination of crew and passengers was carried out at B.K. Hospital Faridabad. The cause of death has been given to be shock resulting from burns and multiple injuries. All injuries were ante mortem in nature.

### **1.14 Fire**

Soot deposit/fire damage was observed on the portion of the aircraft forward of the cargo door. The fire damage/soot deposit was in upward direction. It was a post impact fire.

## **1.15 Survival Aspects**

The blip on radar became static on a radial of 145 deg at 15.2 nm from DPN VOR at 22:42:32 IST. Calls were given to aircraft from 126.35 Mhz. by the TAR controller. Calls were given to the aircraft on 121.5 MHz. At 22:44 IST MLU and JCAC were informed. All others including DC Faridabad were informed as per the procedure. At 22:50 TWR received information from city fire about the aircraft crash. At 22:55 IST city fire gave the location of the crash site as Jawahar Colony, Parvatis Colony near Bata Chowk, Faridabad and that the Faridabad city fire services were attending the fire at the crash site.

There were no survivors since all the occupants had suffered fatal injuries on impact. Immediately on receiving crash information, the police authorities had taken due precautions, to ask for an ambulance in case there were any survivor and fire fighting services.

## **1.16 Tests and Research**

### **1.16.1 Engine Examination**

The power plant investigation was performed on 12-15 July 2011 at Pratt & Whitney Canada Service Investigation Facilities at St. Hubert, Quebec, Canada. The salient observations made during the strip examination are as follows:

- External Condition**

The engine displayed severe impact damage including complete structural separation of the reduction gearbox forward housing and the accessory gearbox



**Engine right hand aft view.**

- **Chip Detectors and Filters:** Accessory Gear box chip detector found free of debris. Oil filter, fuel filter and P3 filter were found clean.
- **Disassembly Observations**

Engine displayed deformation to the compressor 1<sup>st</sup> stage blades



**Compressor 1<sup>st</sup> stage blades, detail**

Engine displayed contact signatures to:

- the compressor axial stages,
- compressor impeller and shroud,
- compressor turbine vane ring baffle,
- compressor turbine,
- 1<sup>st</sup> stage power turbine vane ring and shroud,
- 1<sup>st</sup> stage power turbine,
- 2<sup>nd</sup> stage power turbine vane ring and shroud, and
- 2<sup>nd</sup> stage power turbine

- **Report concludes that**

- **Torsional fracture of the reduction gearbox propeller shaft coupling webs characteristic of the engine producing significant power at impact.**
- The engine gas generator case displayed relatively little impact deformation, limiting the severity of the contact signatures, and precludes definitive assessment of the power level at the start of the impact sequence.
- **No indications of any pre-impact mechanical anomalies or dysfunction to any of the components were observed.**

#### **1.16.2 Flight Controls Test Report**

Trim position of all the axes, flaps and landing gear were determined by M/s Pilatus by comparing the measured dimensions with the test data.

### **1.16.2.1 Main Section**

#### **(i) Aileron trim Position**

The aileron trim actuator is installed in the nose of the left aileron trim and drives the flettner tab via a push rod. A retracted trim actuator deflects the trim tab down which equates to left wing down trim. Stroke length of the actuator is 22.1 mm and the actuator was extended to 8.4 mm approximately 38% of stroke. 0% stroke equates to full left trim and 100% stroke equates to full right trim. Thus, the measured position equates to slight left aileron trim.

#### **(ii) Rudder Trim Position**

The rudder trim actuator is installed in the vertical tail and drives via push-pull rods the trim tab. A retracted actuator drives the trim tab to the right, which in turn moves the rudder to the left. This equates to aircraft nose left trim. At neutral trim setting, the actuating rod is extended by 11mm. At fully retracted position, rod is extended by 3.5 mm and fully extended position rod is extended by 25.6 mm. The rudder trim position of the accident aircraft (actuating rod extended by 17 mm) corresponds to the green take-off position.

#### **(iii) Stabilizer Trim**

The horizontal stabilizer is trimable by means of a nose mounted dual motor, dual load path actuator. A retracted actuator equates to aircraft nose up trim. The safe take-off range for

actuator extension is between 93.7 mm to 125.7 mm. The actuator position of accident aircraft was at 120.3 mm. Therefore, the pitch trim setting of the accident aircraft was in the green take-off range.

#### **(iv) Flap Position**

The flaps are single piece fowler type flaps supported at the three stations per wing. Each center and inboard station is driven by irreversible ball screw actuator operated by a central, fuselage mounted Power Driven Unit (PDU) via high speed drive shafts. Two actuators were found at the wreckage storage location, the left-hand inboard and the right-hand outboard. Both the actuators are fully retracted. This concludes that both the flaps were symmetrically fully retracted.

#### **(v) Landing Gear Position**

The landing gear actuator extension was compared with the design data. Also the extent and nature of damage to the all the three gears was taken into consideration. Based on above the report concludes that “determination of the pre impact gear position could be made although the relatively little damage found on the right hand main and nose gear is an indication that the gear was retracted prior to the impact.”

### **1.16.3 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     Organizational and Management Information**

1.17.1 M/s Air Charter Services Pvt. Ltd. is a Non-scheduled Air Transport Operator engaged in Aircraft charters from its main base at I.G.I. Airport, New Delhi. ACSPL was granted the NSOP No.15/2008 in July 2008. Initially the permit was issued for operation of Beech King Air C-90A. Subsequently, other types of aircrafts like B-200, SKA-300 (350) and Pilatus PC-12/45 were added to the fleet.

Air Charter Services Private Limited (ACSPL) was incorporated as a “private limited” company under Company’s Act of 1956 with Registered Office in Delhi and has been engaged in the business of charter bookings/brokerage, charter operations and associated services. The Organisation is headed by Board of Directors. The Board of Directors & Senior Management Officers are from the field of Aviation/allied services. The Air Charter Services Pvt Ltd provides service to tour operators, tourists and medical evacuation experts. The maintenance of their aircrafts is carried out by M/s Shaurya Aeronautics Pvt. Ltd. M/s Shaurya Aeronautics Pvt. Ltd is DGCA approved Maintenance Organisation.

### **1.17.2 Flight Crew Training**

The company has developed training program for its flight crew in accordance with the relevant civil aviation requirements. The training programme is documented in Part D of the Operations Manual. The training programme covers initial type training, recurrent training etc.

The company has developed in house continuity training programme for operation during adverse weather condition/monsoon condition in accordance with the DGCA Ops Cir 9 of 2010. The instructions are imparted by the senior pilots.

### **1.17.3 Air Ambulance Operation**

No specific procedure has been laid down in the Operation Manual for the conduct of the air ambulance flight. Neither there are any instructions from manufacturer for the air ambulance flight.

Aircraft can be easily converted from the passenger to stretcher configuration. For the carriage of other medical equipment which may or may not draw power from aircraft electric system or dangerous goods items such as oxygen bottles and batteries, no documented procedure has been laid down. Carriage of life saving equipment is decided on the case to case basis without any pre-planning.

### **Regulatory requirements for the Ambulance Flight**

Regulatory requirements for the medical evacuation for non-scheduled operation are contained in CAR Section 3 Series 'C' Part III. They specify the type of the aircraft that can be deployed for medical evacuation flight.

#### **Para 2.3 of the CAR Section 3, Series C part III states that**

*"Operations with single engine aeroplanes shall be conducted only on domestic sectors except for medical evacuation flights and shall be*

*operated along such routes or within such areas for which surfaces are available which permit a safe forced landing to be executed”.*

**Para 9.2** of the same CAR states that “*For operating to international destinations, permission from DGCA shall be obtained for which a notice period of one day will be required. This notice period may be waived off for medical evacuation flights, relief flights, during natural calamities and ambulance flights, in which case the name of the patient and doctor should be provided to DGCA. However, single engine aircraft will not be allowed to operate to International destinations except for medical evacuation flights.”*

**Para 2.3** when read in conjunction with Para 9.2, suggests that single engine aircraft can be used for evacuation/Air Ambulance operation. However content of the Para 2.3 needs to be made unambiguous to afford clear interpretation.

Other requirements regarding loading and C.G limits for the safe operation, minimum crew requirements etc are covered in general in various other Civil Aviation requirements. **The regulation does not specify that the air ambulance flight are to be accorded priority by the air traffic services;** Type and conditions for carriage of medical equipment for the basic life support such as oxygen, suction, stretcher etc and advanced life support, operational and maintenance requirements. Carriage of certain equipment may require the recalibration of aircraft navigation and communication equipment.

### **1.17.3 Flight Safety and Surveillance of Activities**

M/S Air Charters Services Pvt. Ltd has a Flight Safety Officer to oversee the company safety programme and he is directly reporting to Chief Executive Officer. There has been no violation of the FDTL.

### **1.18 Additional information**

On request manufacturer provided data regarding fatal accidents to Pilatus PC-12 type of aircraft. There have been 12 fatal accidents including the present one. In six of the accident the investigation has been completed. Scrutiny indicated inadvertent stall/spin to be cause in two accidents and spiral dive in one accident. Details obtained are placed below:-

S. NO	Date of Accident	Short description	Probable Cause
1	15/02/1998	CFIT in IMC on approach to Wilson Airport, Nairobi, Kenya	CFIT
2	26/05/1998	Loss of control due to flap asymmetry caused by inappropriate crew action	Non adherence to emergency procedures
3	16/09/2002	<b>Aircraft spiral dived out of 13'800 ft into wooded hill.</b>	The pilot's spatial disorientation while turning in a cruise climb in instrument meteorological conditions, which resulted in the pilot's loss of aircraft control and his failure to recover from a resultant tight descending spiral.

4	26/03/2005	Loss of control during final approach	The pilot's failure to maintain sufficient airspeed to avoid a stall during an instrument final approach to land, which resulted in an inadvertent stall/spin. Factors associated with the accident are the inadvertent stall/spin, the pilot's failure to follow procedures/directives, and clouds.
5	25/06/2006	Crash during climb out after touch-and-goes	The flight instructor's failure to maintain an adequate airspeed while maneuvering, which led to an inadvertent stall.
6	30/09/2008	Descended from downwind altitude to ground during base turn	The pilot's incapacitation due to fatigue resulting in an in-flight collision with terrain
7	12/01/2009	Impacted ground shortly after take-off	Under investigation
8	23/03/2009	Impacted ground during approach to diversion airport	Under investigation
9	05/07/2009	<b>Spiral dived from 30'000 ft at high descent rate</b>	Under investigation
10	16/10/2009	Crashed shortly after take-off	Under investigation
11	09/02/2011	Crash into sea	Under investigation

## **1.19 Useful and Effective Investigation Techniques**

Nil

## **2.0 ANALYSIS**

### **2.1 Airworthiness of Aircraft**

#### **2.1.1 Maintenance of Aircraft**

The Certificate of Airworthiness of the aircraft was current and valid. Periodicity of all scheduled maintenance task were maintained. As per the available records no snag was reported during the C of A inspection and also during the period after the issue of C of A till the date of accident. The aircraft was under the maintenance of an approved maintenance organisation. Aircraft Maintenance Engineer who carried out Daily inspection on the day of accident holds A&C Licence and holds full scope approval for maintenance of this aircraft. He did not observe any snag or abnormality during his inspection. Similarly before operating the Patna-Delhi flight the aircraft had operated on Delhi-Chandigarh-Delhi and Delhi-Patna sector and no snag was reported in either of these flights.

Due to the impact of accident and subsequent fire the cockpit of the aircraft was destroyed. Wreckage examination revealed that elevator and rudder control cables were attached. The damage observed to aircraft structure was due to impact and fire. There was no in flight separation of any part or component of the aircraft. Therefore any mechanical failure of aircraft structure or component can safely be ruled out.

## 2.1.2 Serviceability of Engine

The aircraft was descending from FL 160 to FL110 and while it was executing the left turn there was sudden loss of height. Therefore to determine the serviceability of the engine, its investigation was carried out at M/s Pratt & Whitney Canada Service Investigation Facilities at St. Hubert, Quebec, Canada. The investigation revealed:-

- Engine deformation to the compressor 1<sup>st</sup> stage blades and contact signatures to
  - the compressor axial stages,
  - compressor impeller and shroud,
  - compressor turbine vane ring baffle,
  - compressor turbine,
  - 1<sup>st</sup> stage power turbine vane ring and shroud,
  - 1<sup>st</sup> stage power turbine,
  - 2<sup>nd</sup> stage power turbine vane ring and shroud, and
  - 2<sup>nd</sup> stage power turbine
- Torsional fracture of the reduction gearbox propeller shaft coupling webs characteristic of the engine producing significant power at impact.  
**This indicated that there were not any pre-impact anomalies or dysfunction to any of the components observed and engine was producing power.**

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

## **2.2 Weather**

IMD had analyzed development and movement of various clouds during the period of this flight to IGI airport available at each 30-minutes from Satellite and at each 10 minutes from Doppler Weather RADAR (DWR) in Fig 3.7, Fig 3 (a-e) as per IMD report attached as Appendix "A". Location of flight was plotted at 22:00 IST and 22:30 IST in these cloud pictures to find just before the accident what might be cloudy conditions in its flight path. It showed by 22:00 IST in Fig 3 (d) of IMD report placed as Appx "A", development of convective clouds was detected at the approach path of the flight which was not so prominent in the previous Satellite pictures in Fig 3 (a-c) of IMD report placed as Appx "A". While by 22:30 IST just before the accident, the flight was further near to the convective clouds. Further the cloud development near Southeast Delhi and adjoining east Haryana and UP

border had occurred during 22:00-23:00 IST when the flight was approaching IGI for landing from Faridabad side. **District wise cloud map from satellite in Fig 4(a-b) of the IMD Report placed as Appx "A", showed development of secondary CB zones by 22:10 IST near but at NE of the airport and east of the airport with in 100km distances, while Fig 5(a-d) of the IMD Report placed as Appx "A", major CB and other cloud pattern still located far at 100-250km at its northeast of IGI Airport which was located over Uttaranchal.** DWR estimates in Fig 6(a-b) of the IMD Report placed as Appx "A", indicated these CB clouds had vertical extension up to 12km and these tall CB clouds were at the right approach path of the flight movement which were moving towards ESE sectors. **DWR wind estimations Fig 7(a-f) of the IMD Report placed as Appx "A", indicated that the winds at 6500 feet AGL near the affected flight was 70-90kts from North northwest-Very strong turbulences and, the winds at 9800 feet AGL near the affected flight was 30-50kts from South southeast.**

**Crew of the other aircraft who had earlier over flown this area had reported moderate to high turbulent weather conditions and in one case the autopilot of an Airbus 320 had cut off due to turbulence.**

From above it appears that the flight path of the aircraft was enveloped by secondary CB cells whose height was around 12 km. There was no reported defect of the aircraft weather radar. The crew asked for the change in heading after the controller asked him of weather conditions at radial 330. The air traffic controller has no display of the fast changing weather scenario at his position and therefore his guidance is based on the information received from the aircraft.

The flight manual cautions against only severe icing conditions and prescribes that crew should immediately request priority handling from Air Traffic Control to facilitate a route or an altitude change to exit the severe icing conditions in order to avoid extended exposure to flight conditions more severe than those for which the airplane has been certificated.

In the present case severe icing conditions does not appear to have existed. At 22:38:12 IST Approach gave aircraft left heading 285 which was copied by the aircraft. While the aircraft was executing a left turn to the cleared heading and descending to cleared level of 110, at 22:39:42 IST it started climbing with corresponding drop in the ground speed. At 22:40:02 IST it had reached a FL141 and subsequently up to 22:40:17 IST there was sudden sharp left descending turn. This suggests that aircraft was hit by a strong gust, which raised its pitch attitude and resulting in left turning stall. At 22:40:43 IST aircraft transmitted that "**Into bad weather**". Again at 22:41:32 IST aircraft transmitted "**Into bad weather**". By this time the aircraft had descended to FL078.

The company has in house continuity training programme for the crew during the adverse weather/ monsoon conditions in accordance with DGCA Ops Circular 9 of 2010. The fuel onboard was sufficient for the flight.

**Thus from the weather analysis it is apparent that the there were fast changing weather conditions and secondary CB cells existed on the flight path of the aircraft. These conditions has effected the flight.**

## 2.3 Crew Qualification

Both the crew held valid license and were qualified on type. Their ratings were current. The PIC had a total flying experience 1521:05 Hrs out of which 1300 hrs were on Pilatus PC-12 type of aircraft. In accordance with DGCA Ops Circular 9 of 2010, he had undergone adverse weather/monsoon training and Check for release as commander for operation during the adverse weather/Monsoon. The copilot had total flying Experience of 300 hrs out of which 70 hrs were on type of the aircraft. Organisation has in place continuity training programme for the adverse weather operation in accordance with DGCA Ops Circular 9 of 2010.

Para 3(vii) of CAR Section 8 Series A part I requires that

*The following category of aircraft irrespective of seating capacity and All-up-weight, when required to be flown under instrument flight rules, shall be operated by two pilots*

- a) *aircraft powered by one or more Turbo Jet or Turbo fan engines;*
- b) *aircraft powered by one or more Turbine Propeller engines and provided with a means of pressurising the passengers cabin;*
- c) *aircraft powered by two or more Turbine Propeller engines and not provided with a means of pressurising the passengers cabin unless it is equipped with a certified autopilot.*

In accordance with these requirements the aircraft was being operated by two-member crew who were qualified on type of the aircraft. The total cockpit experience of Pilot and Copilot was more than 500 hrs on type.

## 2.4 Air Ambulance Service

Air ambulance services consist of transportation of ambulatory or other patients requiring special care, including basic life support or advanced life support. Air ambulances are frequently called to respond to accident scenes that are remote, or far from a trauma center. They are also required to fly in poor weather conditions, at night, and navigate challenging terrain.

At present Air ambulances are not regulated separately from other General Aviation flights. Regulatory requirements for the medical evacuation/Air Ambulance for non-scheduled operation are contained in **CAR Section 3 Series 'C' Part III**. They specify only the type of the aircraft that can be deployed for medical evacuation flights. Other requirements regarding loading and C.G limits for the safe operation, minimum crew requirements etc are covered in general in various other Civil Aviation requirements.

Air Ambulance flights involve carriage of the medical equipment for the basic life support such as oxygen, suction, stretcher etc and advanced life support. In absence of specific regulation, the equipment carried on board is dictated by the requirement of each case and is provided by the hospital chartering the flight. These equipment may or may not conform to the aviation standards. Also some specialized equipment may require the recalibration of aircraft navigation and communication equipment due to radio frequency/electromagnetic interference. Further the large carry-on medical equipments must be restrained to meet the specified load factor requirements. Also there is need for the storage racks that meets the g-load requirements of emergency landing for the equipment being carried for the patient care.

Accordingly in the present case no specific procedure has been laid down in the Operation Manual for the conduct of the air ambulance flight. Neither there are any instructions from manufacturer for the air ambulance flight.

**Absence of specific regulation addressing issues such as mentioned above raises question about the safety of these flights, particularly given the challenging missions they fly and the destinations they serve. Considering the rapid growth in this sector, there is urgent need for the specific regulation.**

### **3. CONCLUSION**

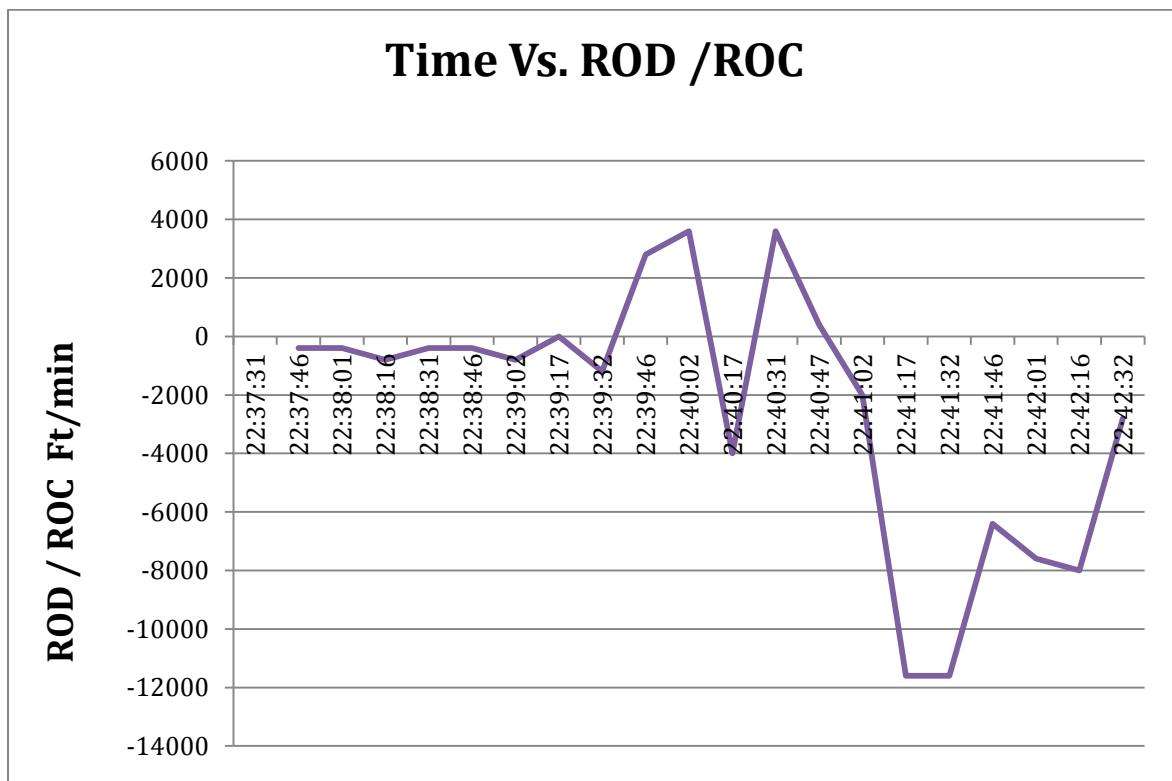
#### **3.1 Findings:**

3.1.1.1 VT-ACF was cruising at FL260 till 22:15:31 IST at 105.5 nm from DPN on a radial of 115°. At this time the aircraft had commenced a gradual descent to attain FL 115 as per ATC instructions. The aircraft continued to maintain a track of 286°. The descent was continued to an altitude of 12,500 ft. till 22:39:32 IST with minor variations in track. During the next three minutes, from 22:39:32 to 22:42:21 IST, the aircraft has departed controlled flight and is known to have impacted the ground.

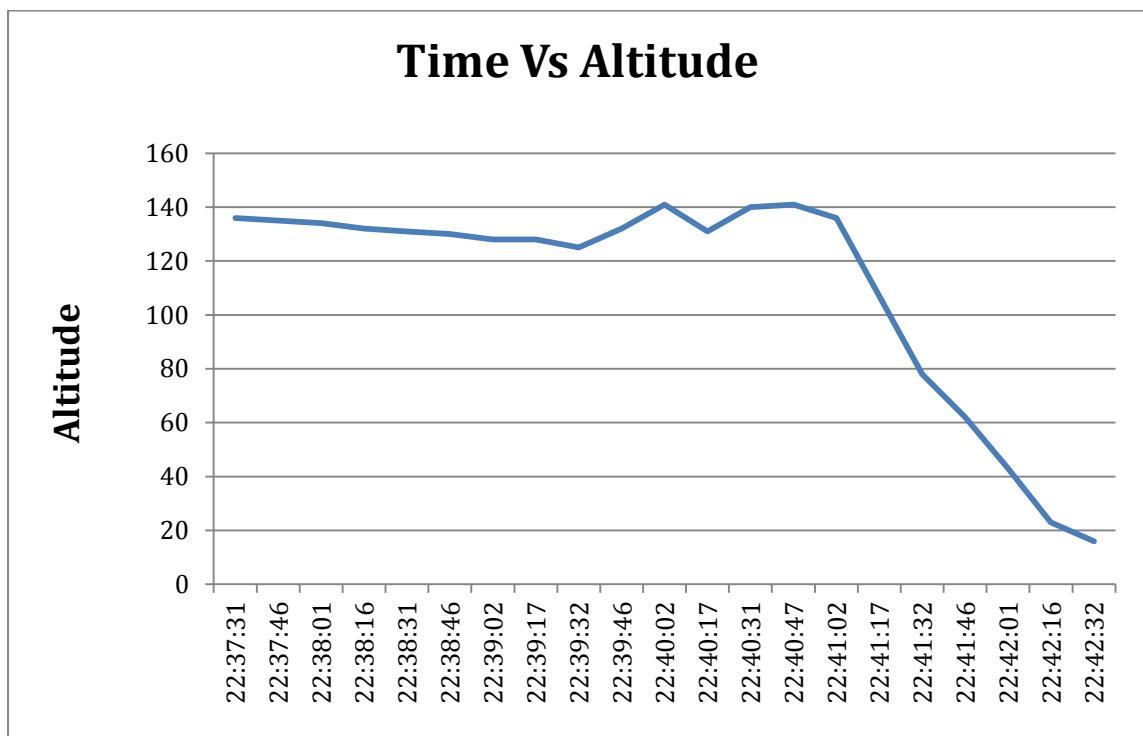
3.1.1.2 From the Radar data as provided by Air Traffic Control at IGI Airport, the following graphs were constructed as follows:-

### 3.1.1.3

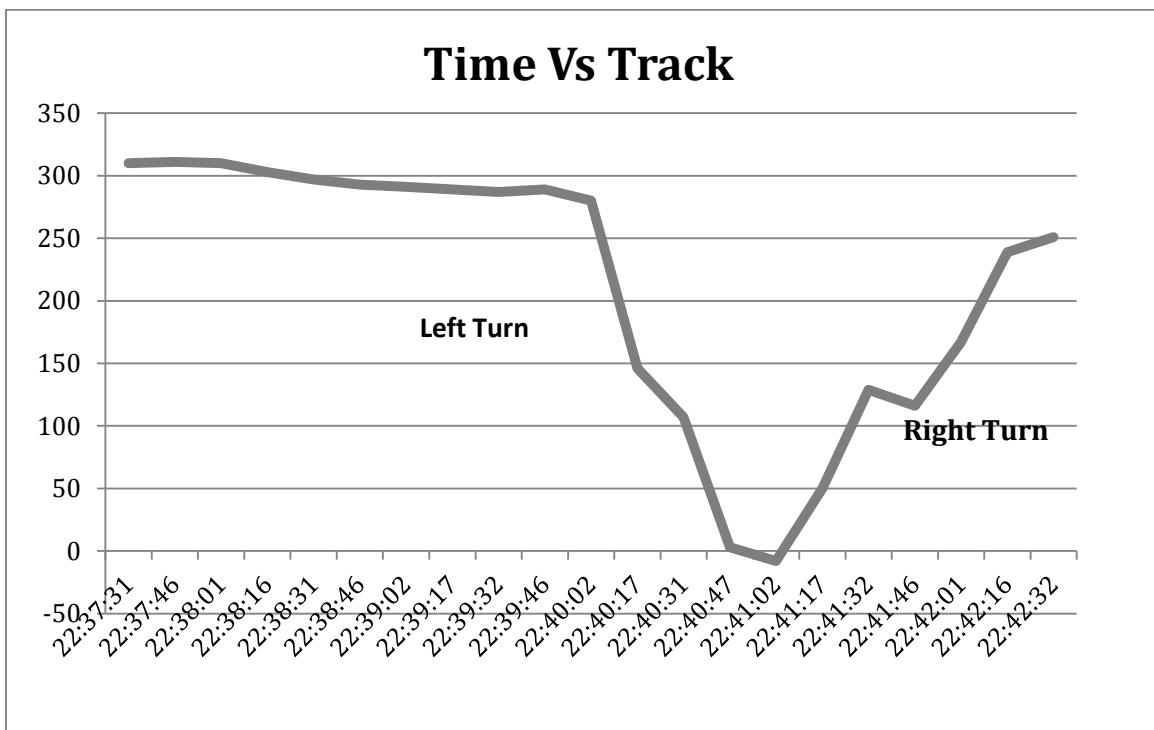
**Fig 3. (From 22:37:46 IST to 22:42:32 IST)**



**Fig 4. (From 22:37:46 IST to 22:42:32 IST)**

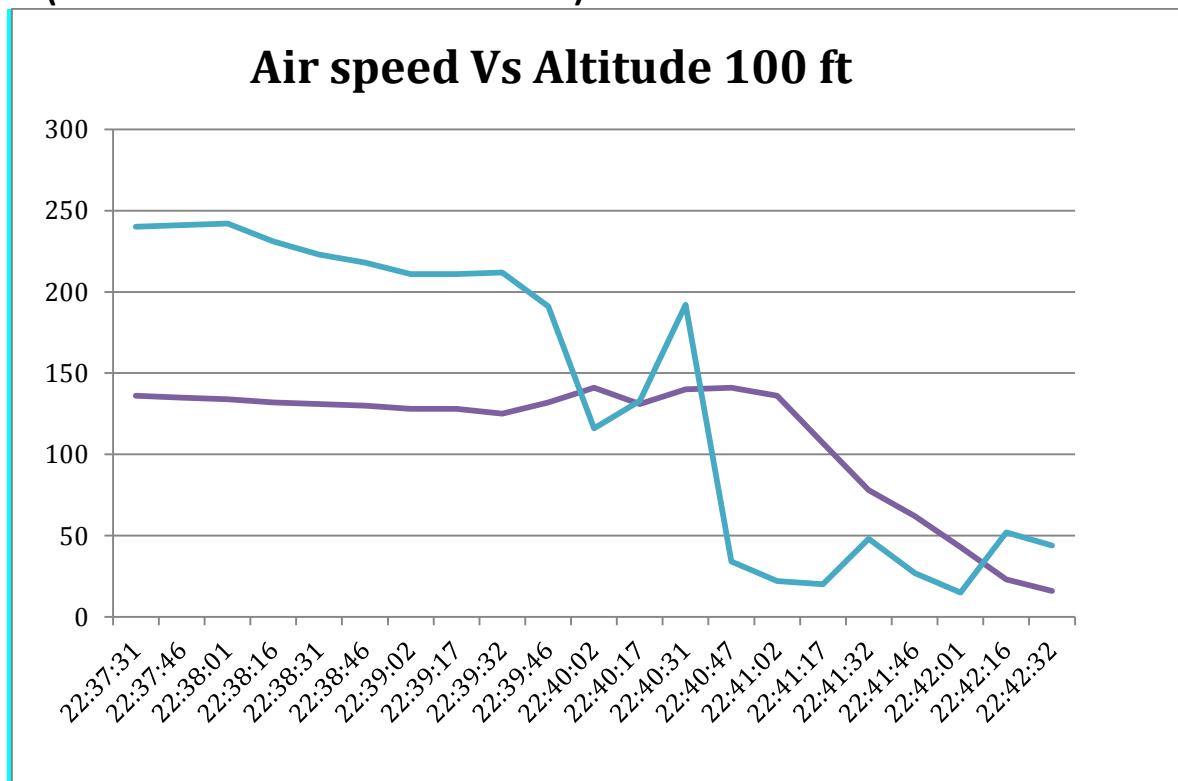


**Fig5. (From 22:37:46 IST to 22:42:32 IST)**



**Fig6. Air Speed and Altitude vs Time**

(From 22:37:46 IST to 22:42:32 IST)



In the absence of an FDR, CVR or any other recording devices, which could have contributed in establishing the cause, the Radar Data became the primary source of information.

3.1.1.4 It appears that the aircraft had rapidly gained height from 12,500 ft. to 14,100 ft. (Refer Fig6.) at 22:39:32 IST with a substantial ROC coupled with a marked reduction of Ground Speed. The aircraft has thereafter descended just as rapidly by 1000 ft. to 13,100 ft (Refer Fig6.) by 22:40:17 IST, indicating the aircraft had encountered an up draft followed by a down draft. The aircraft again appears to have hit another updraft at this juncture and has rapidly climbed once again to 14,600 ft (Refer Fig6.) at 22:40:37 along with a rapid drop in speed and in an abrupt climbing turn to the left. This rapid climb coupled with the excessive drop in speed appears to have caused the aircraft to have departed controlled flight at 22:40:37 IST.

Thereafter, the aircraft was in a departed state, with the ground speed rapidly reducing and a substantial and continuous loss of altitude. **The computed descent rates have been as high as 11,600 ft/min and the derived turn rate as high as 40 deg/sec (Refer Fig3. And Fig5.).**

At 22:41:02 IST the turn to the left has been abruptly reversed and a persistent cork-screw turn to the right has commenced, which has continued till below 1600 ft at which stage, radar contact was lost at 22:42:21 IST just prior to impact with the ground.

**The ground position of the aircraft has remained within 0.2nm (370m) of the initial position for the last two minutes prior to crash (loss of**

data), and is clearly indicative of a departed state with over 12,000 ft loss of altitude in that short time frame.

3.1.1.5 It is probable that a series of up and down drafts, turbulence (moderate to heavy) and in dark night conditions caused the crew to become disoriented. The subsequent mishandling of controls caused the aircraft to enter as incipient spin. The rapid onset rate of the spin and high descent rate resulted in the crew being unable to recognize the phenomenon, which they were experiencing, perhaps for the first time. This probably caused them to react erroneously resulting in as aggravation of the situation and ultimate loss of control till impact with the ground.

3.1.5 Development and movement of various clouds during the prior of the ill fated flight to IGI Airport, with 30 minutes each of satellite picture and 10 minutes from Doppler Weather Radar were analysed. Location of flight was plotted at 22:00 IST and 22:30 IST with respect to cloud conditions. Development of convective clouds was detected which was not so prominent in the previous reports. It was discernable that the flight path of VT-ACF whilst approaching IGI Airport was surrounded by secondary CB cells to the right. DWR wind estimations (Appendix "A") indicated that the winds at 6500 ft A6L near the affected flight was 70-90 kts from NW direction and gusting with strong turbulence. The winds at 9800 ft A6L were gusting between 30-50 kts. Crew of other aircraft who had earlier flown through the same area reported moderate to severe turbulence. Flight manual cautions against severe icing conditions and actions to be taken during such conditions. Severe icing conditions did not exist although IMD had included severe icing in their cautionary report.

3.1.6 It is evident that pilot entered bad weather from the two radio calls given by him “into bad weather” at which point the aircraft had descended to FL 078.

3.1.7 Para 2.3 and Para 9.2 of CAR Section 3, Series ‘C’, Part III with respect to single engine aircraft being permitted for medical evacuation missions is ambiguous.

3.1.8 The pilots were holding valid flying licenses and rating for conduct of the flight. The crew were qualified on aircraft type and total cockpit experience was more than 500 hrs on type, as required.

3.1.9 The aircraft had a valid airworthiness certificate in accordance with CAR Section 2, Series ‘F’, Part V. There was no snag or mechanical failure of any of the components before impact. There was no dysfunction of engine. These findings are confirmed by M/s Pratt & Whitney, Canada and M/s Pilatus Aircraft Ltd, Stans, Switzerland.

3.1.10 M/s Air Charter has an in house continuity training program for air crew towards adverse weather/monsoon conditions as per DGCA operation circular 9/2010.

3.1.11 Air traffic controllers do not have real time weather information available. Only forecast weather, trends and periodic information is available. As a consequence the controllers were not able to provide any meaningful support to VT-ACF. Perhaps the controllers need to be more cautious in monitoring the progress of light weight aircraft more closely.

3.1.12 From scrutiny of fatal accidents on Pilatus PC-12 type of aircraft, it is known that **there have been two cases of stalled spiral/spin and one of aircraft spiraling into the ground from 13,800 ft.** As per the AFM issued by the OEM on operative stall protective system, ensures that the aircraft cannot achieve AOA associated with natural aerodynamic stall. According to FAR Part 23 the aircraft was demonstrated as spin resistant. However the aircraft, under severe turbulence conditions associated with vertical currents may depart from controlled flight.

### 3.2 Cause:

**The probable cause of the accident could be attributed to departure of the aircraft from controlled flight due to an external weather related phenomenon, mishandling of controls, spatial disorientation or a combination of the three.**

## 4. SAFETY RECOMMENDATIONS:

4.1 Weather information received by IMD from DWR in real time should be duplicated at the working consoles of the Air Traffic Controllers. This would help them ensure a proactive approach in their controlling to avoid aircraft entering severe weather conditions.

4.2 It must be ensured that all air crew are made to undergo realistic training to include low speed handling and unusual altitudes and recovery from such flight conditions for aircraft types flown. The necessity for manual flying training cannot be over emphasized.

4.3 DGCA may issue necessary amendments to CAR Section 3, Series 'C', Part III to ensure that its interpretation is unambiguous with respect to single engine aircraft for Medical Evacuation Missions. There is no specific CAR that has been issued for Air Ambulance Operations. Considering that the traffic in this role is likely to expand rapidly, it needs to be regulated.

4.4 Accident/Incident Investigation is difficult and often speculative in the absence of flight data recorders. All aircraft irrespective of all up weight category should be equipped with CVR/FDR or any other recording device for purposes of accident/incident investigation.

4.5 It is recommended that a “Civil Aviation Authority” be commissioned which would have the following mandate.

- a. Independent examining boards for Air Crew, Ground Crew and Cabin Crew.
- b. Independent financial powers including powers to hire staff at prevailing commercial rates.
- c. Independent functional control with the administrative control and under the Ministry of Civil Aviation.

4.6 Central government should setup an independent “Accident Investigation Bureau” in accordance with International Standards for investigations of accidents and serious incidents. Further the Accident Investigation Bureau should have financial and administrative independence.

4.7 Defense procurement policy of year 2010 has been modified to include Commercial Aviation in the offset clause. This implies that defense offset investment could also be utilised to the optimal level in the Civil Aviation Sphere.



(Capt Kishore Chinta)

Member



(S S Nat)

Member



(Air Marshal (Retd) P S Ahluwalia)

Chairman of Enquiry Committee

## **GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT**

<b>AAI</b>	:	Airports Authority of India
<b>AAIB</b>	:	Aircraft Accident Investigation Board
<b>ACSPL</b>	:	Air Charter Services Pvt. Ltd.
<b>AME</b>	:	Aircraft Maintenance Engineer
<b>AMSL</b>	:	Above Mean Sea Level
<b>AOA</b>	:	Angle of Attack
<b>ATC</b>	:	Air Traffic Control
<b>ATCO</b>	:	Air Traffic Control Officer
<b>ATPL</b>	:	Air Transport Pilot License
<b>ATS</b>	:	Air traffic Service
<b>BECMU</b>	:	Becoming
<b>CAR</b>	:	Civil Aviation Requirements
<b>CB</b>	:	Cumulonimbus Clouds
<b>CPL</b>	:	Commercial Pilot License
<b>CVR</b>	:	Cockpit Voice Recorder
<b>DPN(VOR)</b>	:	Delhi VOR
<b>DV</b>	:	Direct Vision
<b>DWR</b>	:	Doppler Weather Radar
<b>EASA</b>	:	European Aviation Safety Agency
<b>EET</b>	:	Estimated Elapse Time
<b>ELT</b>	:	Emergency Locator Transmitter
<b>ETA</b>	:	Estimated Time of Arrival
<b>ETD</b>	:	Estimated Time of Departure
<b>FDR</b>	:	Flight Data Recorder
<b>HZ</b>	:	Haze
<b>IAL</b>	:	Instrument Approach to Land Procedure
<b>ICAO</b>	:	International Civil Aviation Organization
<b>IFR</b>	:	Instrument Flight Rules
<b>IMC</b>	:	Instrument Metrological Conditions
<b>IMD</b>	:	Indian Meteorological Department
<b>IST</b>	:	Indian Standard Time
<b>JE</b>	:	Jet Engine

<b>NSOP</b>	:	Non-Scheduled Operator's Permit
<b>PDU</b>	:	Power Driven Unit
<b>PIC</b>	:	Pilot-in-Command
<b>QNH</b>	:	Pressure Setting to Indicate Elevation
<b>QNF</b>	:	Local Altimeter Setting
<b>ROC</b>	:	Rate of Climb
<b>ROD</b>	:	Rate of Descent
<b>RSR</b>	:	Route Surveillance Radar
<b>R/W</b>	:	Runway
<b>SIGMET</b>	:	Significant Meteorology
<b>SKC</b>	:	Sky Clear
<b>TAR</b>	:	Terminal Approach Radar
<b>TEMPO</b>	:	Temporary
<b>TS</b>	:	Thunderstorm
<b>TSB</b>	:	Transport Safety Board
<b>TSN</b>	:	<i>Time Since New</i>
<b>TWR</b>	:	Air traffic Control Tower
<b>TSO</b>	:	Time Since Overhaul
<b>VIDP</b>	:	IGI Airport, New Delhi
<b>VFR</b>	:	Visual Flight Rules
<b>VHF</b>	:	Very High Frequency
<b>VMC</b>	:	Visual Meteorological Conditions
<b>VOR</b>	:	VHF Omni Range
<b>WSO</b>	:	Watch Supervisory Officer

## **APPENDIX-A**

**Airport Meteorological Office**

**Indira Gandhi International (IGI) Airport, New Delhi-110037**

**Report of the Aircraft accident as per ATC IGI Airport reported to Meteorological Office, IGI Airport, Palam and Objective of the present Report**

As per the tentative report from ATC New Delhi ,an aircraft NO:VTACF POB07 from Patna to Delhi from 146 degree direction with 16n/mile flying at f/l 16000ft crashed at Faridabad(Bata Chowk), Haryana on 25.05.2011 at .( as informed by police control to ATS at 25/1718 UTC (2248 IST). Total No. of persons on board: Seven (7); No. of passengers : five(5), No. of pilots : two (2).

In the present report, various weather observations including weather warnings and forecasts provided to ATC and other aviation users on real time on 25 May 2011 for safe flight operation at IGI airport and 100 NM around have been documented in Sec. 2 while Sec 3 deals with the cloud pictures from Doppler Weather RADAR(DWR) at each 10 minutes and Satellite pictures at each 30 minutes with marking of the aircraft location as estimated from ATC RADAR which was faced accident over Faridabad..

**2. Weather conditions during the period of the accident and the forecast/warnings issued from the Meteorological Office, IGI Airport.**

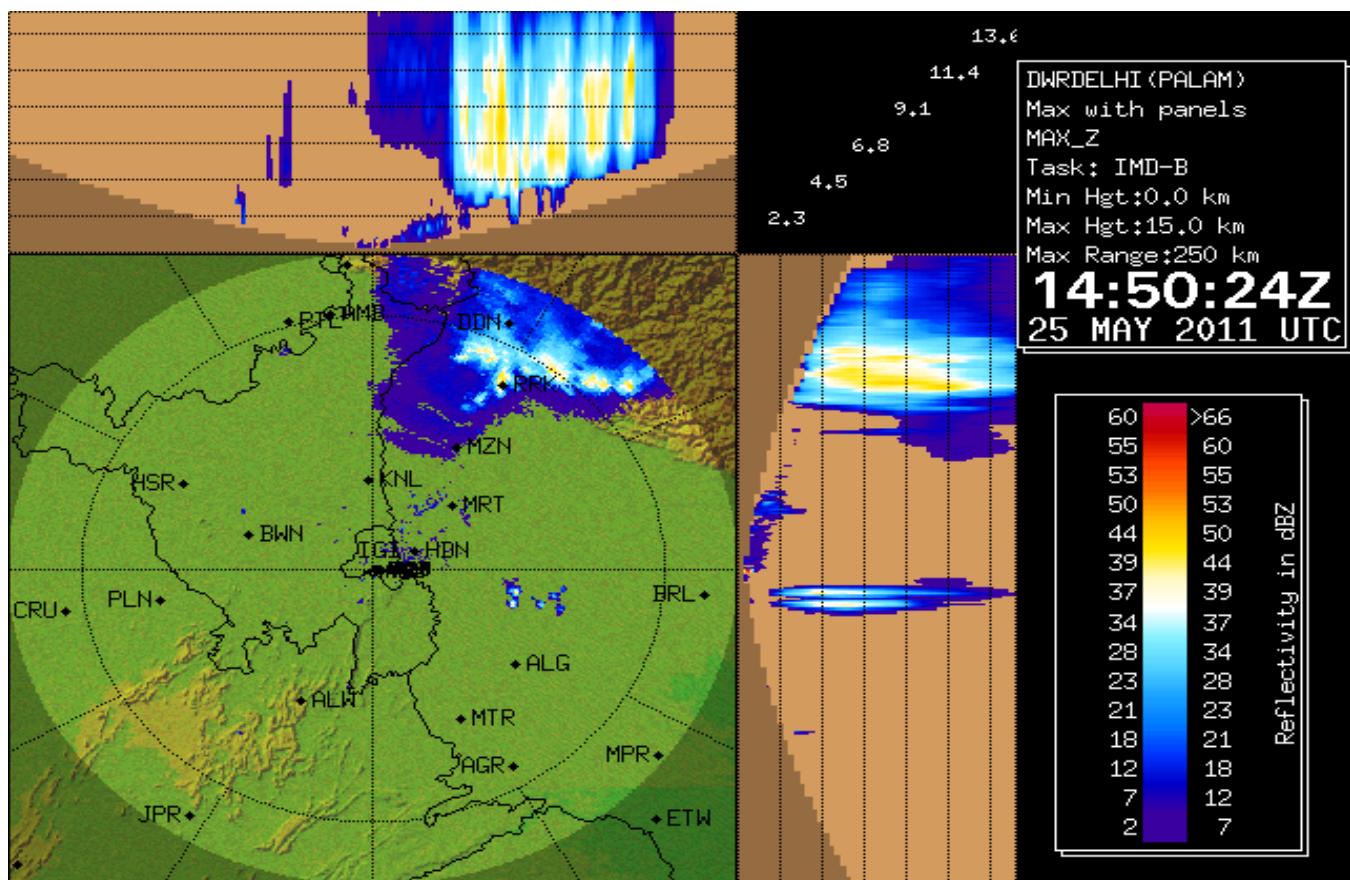
***2.1.The brief description of the various weather conditions observed during 2030 IST to 2330 IST as reported in the current weather (i.e. Met reports or METAR) along with trend forecast and weather warnings based upon various meteorological instruments at various RWY ends, DWR, Satellite weather data etc is as follows:-***

Current weather reports as issued by the Met Office for the period (decoded/simplified version of MET REPORT issued to ATC given in Table- 1) shows the airport was having visibility at 2030 IST as 3500 meter in haze with low and medium clouds of height 4000 to 10000 feet with wind 270 Deg/5 Knots which deteriorated to 3000 meter at 2052 IST when CB cloud was also reported for the first time during the period (see Table 1). DWR from 2010 IST (Fig. 1) was showing movement of CB clouds to the circular domain within the 100NM of IGI due to which a weather warning for squall was issued at 2030 IST valid for 2130 IST to 0130 IST indicating “**IGI Airport and 100 nautical mile around is likely to be affected by Dust storm/Thunderstorm when the surface wind speed in associated squall will likely to reach from 030 deg Direction with speed exceeding 30kts/60kmph”**(Weather warnings as issued given in Annexure-A). A trend forecast of this weather warnings for ATC/PILOT was appended in the SPECI/METAR issued at 2052 IST with TEMPO 030/30KTS VIS 1500M IN TS/RA. The observations from Integrated Automatic Surface weather observing Instruments (IASWOI) confirms the weather conditions deteriorated started at 2230 IST when the RWY 27 end experienced squall/gusty winds of 31 kts/62 kmph from 040 deg which subsequently spread to various other five RWY ends. The wind speed recorded at RWY 27 ends by integrated aviation AWS have been enclosed for confirmation (Fig. 2). Accordingly a SPECIAL weather report was issued at **2230 UTC to ATC with prevailing weather conditions as TS/DS and gusty winds of 040/20 kts gusting to 30 kts**. Due to such bad weather occurrences, the trend forecast was also continued to be appended with likely of visibility reduction to 1500 M in TS/RA. In view of

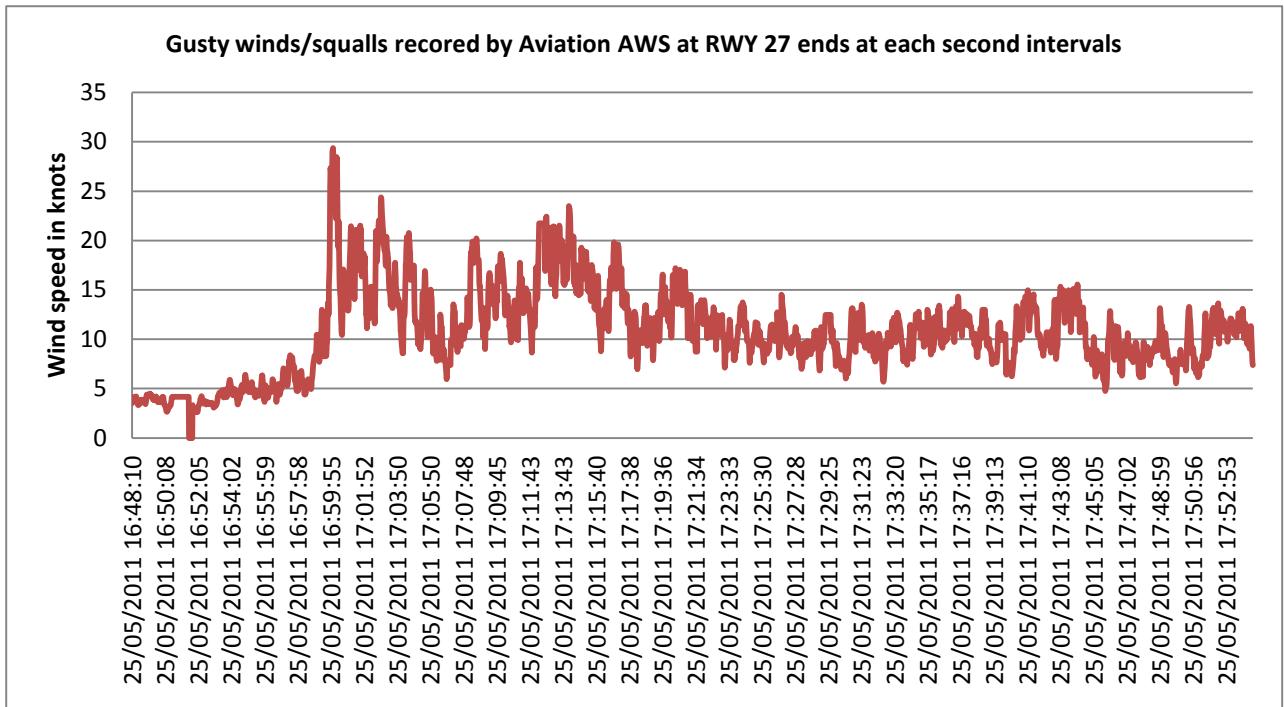
gusty wind conditions continuing with visibility falling to 1500 M in TS another 2<sup>nd</sup> SPECIAL Weather report was issued to ATC at 2251 IST when surface wind was reported as 050/20kt gusting 30 kts with current weather as TS. Hereafter the weather started improving and by 2330 IST, the visibility was improved to 2500M in haze and ceased off TS.

## 2.2 Review of other Various Weather Warnings and Forecasts of Met

Aerodrome forecast of IGI Airport issued at 1730 IST of 25 May valid for 2030 IST to 0530 IST of 26 May indicated likelihood of occurrences of TS/RA with wind squalls/gusty winds of 30kts from NW-290 deg and deterioration of visibility up to 1200 during 2030 IST to 0530 IST. Local forecast issued at 1900 IST of 25 May valid for 1930 IST to 0330 IST for IGI Airport and 100 nautical mile around also included likelihood of severe turbulence and moderate icing due to development of CB and likely occurrences of TS. SIGMET Warning issued during 25 May 1530 IST till 0330 IST also having warnings of CB/TS forecast in the Delhi FIR region based upon DWR and satellite observations.



**Fig. 1. DWR Cloud pictures as early as 2020 IST confirms the development of vertically grown up CB clouds at NNE to IGI Airport at 100km to 200 km circles over Uttarakhand hills based upon which IMD issues warning of DS/TS and squally/gusty weather**



**Fig. 2.** The observations from various Integrated Automatic surface weather Instruments confirms the weather conditions deteriorated at 2230 IST when the RWY 27 end experienced squall/gusty winds of 31 kts/62 kmph from 040 deg which subsequently spread to various other five RWY ends

### 3. Characteristics of Clouds as detected by Satellite and DWR

We have analysed development and movement of various clouds during the period of this flight to IGI airport available at each 30-minutes from Satellite and at each 10 minutes from Doppler Weather RADAR(DWR) in Fig. 3-7. Fig 3(a-e) shows 30 minutes gap satellite clouds of the region during 2200-2259 IST of 25 May 2011. We have also plotted location of flight at 2200 IST and 2230 IST in these cloud pictures to find just before the accident what might be cloudy conditions in its flight path. It shows by 2200 IST in Fig 3d, development of convective clouds have been detected at the approach path of the flight path which was not so prominent at previous Satellite pictures in Fig. 3 a-c while by 2230 IST just before the accident, the flight was further near to the convective clouds . One may also note from these cloud pictures that cloud development near Southeast Delhi and adjoining east Haryana and UP border was occurred during 2200-2300 IST when the flight was approaching to IGI for landing from Faridabad side. District wise cloud map from satellite shows same in Fig 4 a-b. **Fig. 5(a-d) shows 250km range DWR MAX Z cloud Pictures of the period with the Flight locations (ATC RADAR estimates received from ATC, AAI, during the period 2210-2240 IST.** It shows development of secondary CB zones by 2210 IST near but at NE of the airport and east of the airport with in 100km distances while

major CB and other cloud pattern still located far at 100-250km at its northeast of IGI Airport which was located over Uttarakhand. DWR cloud heights as per DWR estimates in Fig. 6 a-b show these CB clouds have vertical extension up to 12km as height estimated by DWR and these tall CB clouds were at the right approach path of the flight movement which were moving towards ESE sectors. **Fig.7(a-f) shows wind estimated by DWR at two heights along with corresponding estimated location of the flights from ATC RADAR . It shows in Fig 7 a, c, e-as per DWR wind estimations, the winds at 6500 feet agl near the affected flight was 70-90kts from North northwest-Very strong turbulences and in b, d, f-As per DWR wind estimations, the winds at 9800 feet agl near the affected flight was 30-50kts from South southeast.**

**Table-1 CURRENT WEATHER REPORT FOR 25.05.2011 provided to ATC at various real time**

TIME IST	TYPE OF MESSAGE	VIS	PRESENT WEATHER	WIND DIRECTION	WIND SPEED	TREND FORECAST
<b>2030</b>	MEATR	3500	DUST	270	05KT	BECMG VIS 3000M
<b>2052</b>	SPECI	3000	HAZE	260	05KT	TEMPO 03030KT 1500M TSRA
<b>2130</b>	MEATR	3000	HAZE	290	04KT	TEMPO 03030KT 1500M TSRA
<b>2200</b>	MEATR	3000	HAZE	310	04KT	TEMPO 03030KT 1500M TSRA
<b>2230</b>	MEATR	2100	HAZE	040	<b>20G30KT</b>	TEMPO 1500M TSRA
<b>2251</b>	SPECI	1500	<b>DS/TS</b>	050	<b>20G30KT</b>	TEMPO 0800 TSRA
<b>2305</b>	SPECI	2000	<b>TS</b>	060	<b>08G18KT</b>	TEMPO 1500M TSRA
<b>2330</b>	SPECI	2200	HAZE	080	10KT	TEMPO 03030KT 1500M TSRA

#### Annexure-A

**AERODROME WARNING OF DELHI AIRPORT DATED 25-05-2011 ISSUED AT 2100 IST TO  
ATC(ATC OFFICERS SIGNATURE IS THERE THAT HE RECEIVED IT AT 2115 IST)**

**WOUT90 VIDP 251500aaa AERODROME WARNING**

**THUNDERTSORM/DUSTORM IS LIKELY TO AFFECT VIDP AERODROME DURING THE  
PERIOD FROM 25/1600UTC TO 25/2000UTC WHEN SURFACE WIND SPEED IN ASSOCIATED  
SQUALL FROM 030 DIRECTION AND EXCEED 30 KNOTS=**

25MAY2011 1500UTC

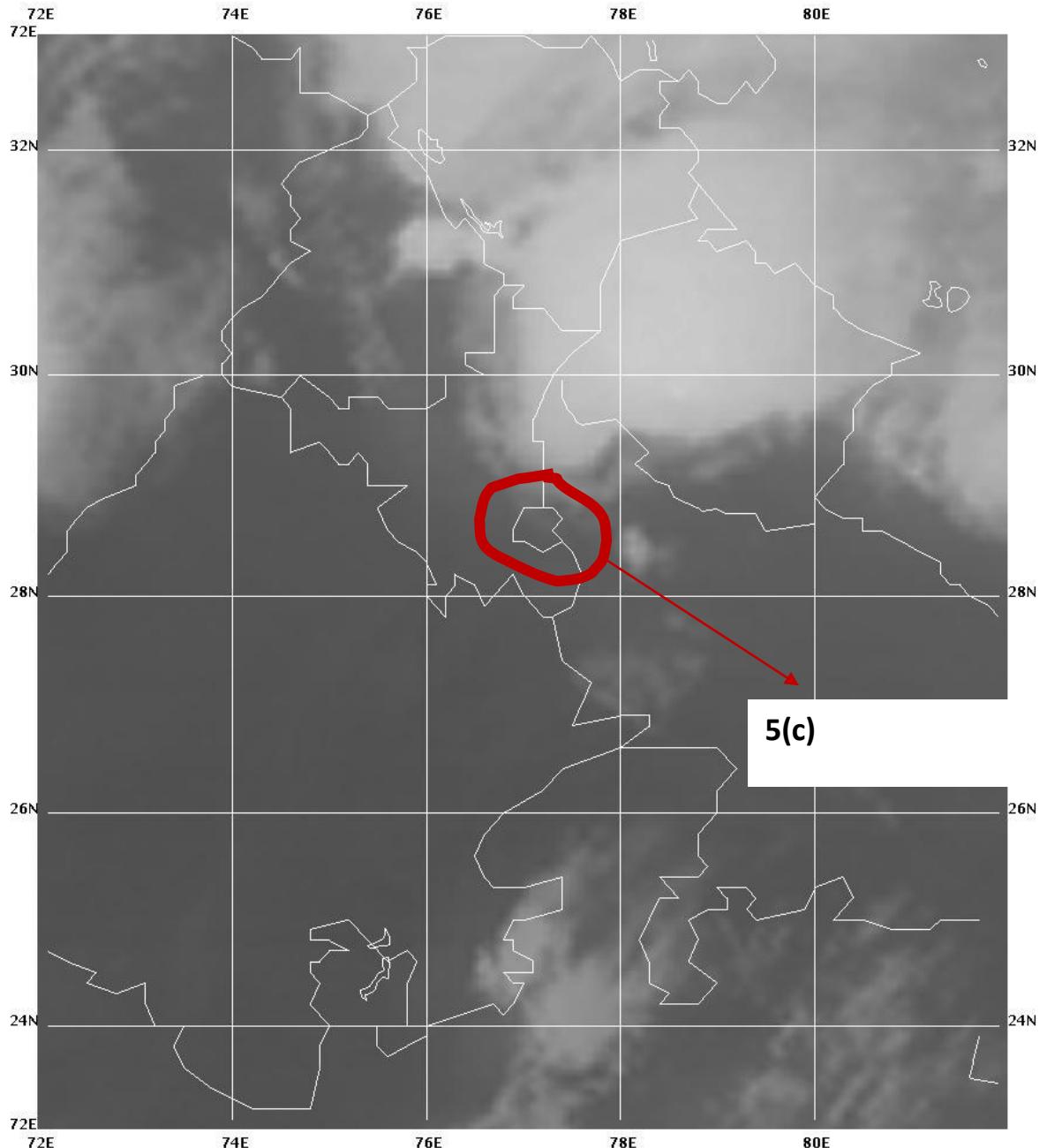
Sensor : VHRR

SAT : KALPANA-1

Special

Proj : MERCATOR

Resolution : 1084 m



**Fig 3a:** Satellite pictures of North India at 2030 IST

25MAY2011 1530UTC

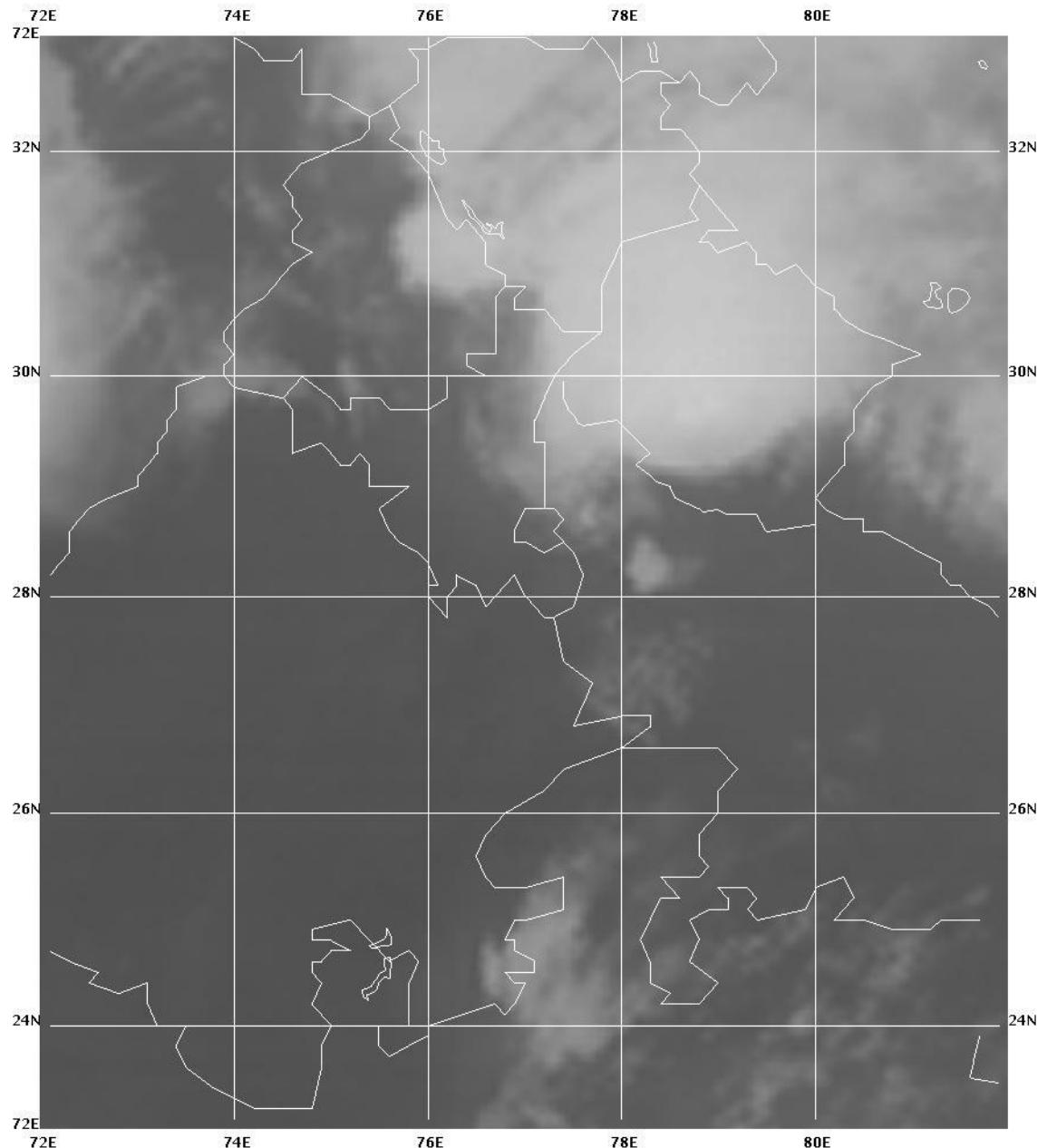
Sensor : VHRR

SAT : KALPANA-1

Special

Proj : MERCATOR

Resolution : 1084 m



**Fig 3b:** Satellite pictures of North India at 2100 IST

25MAY2011 1600UTC

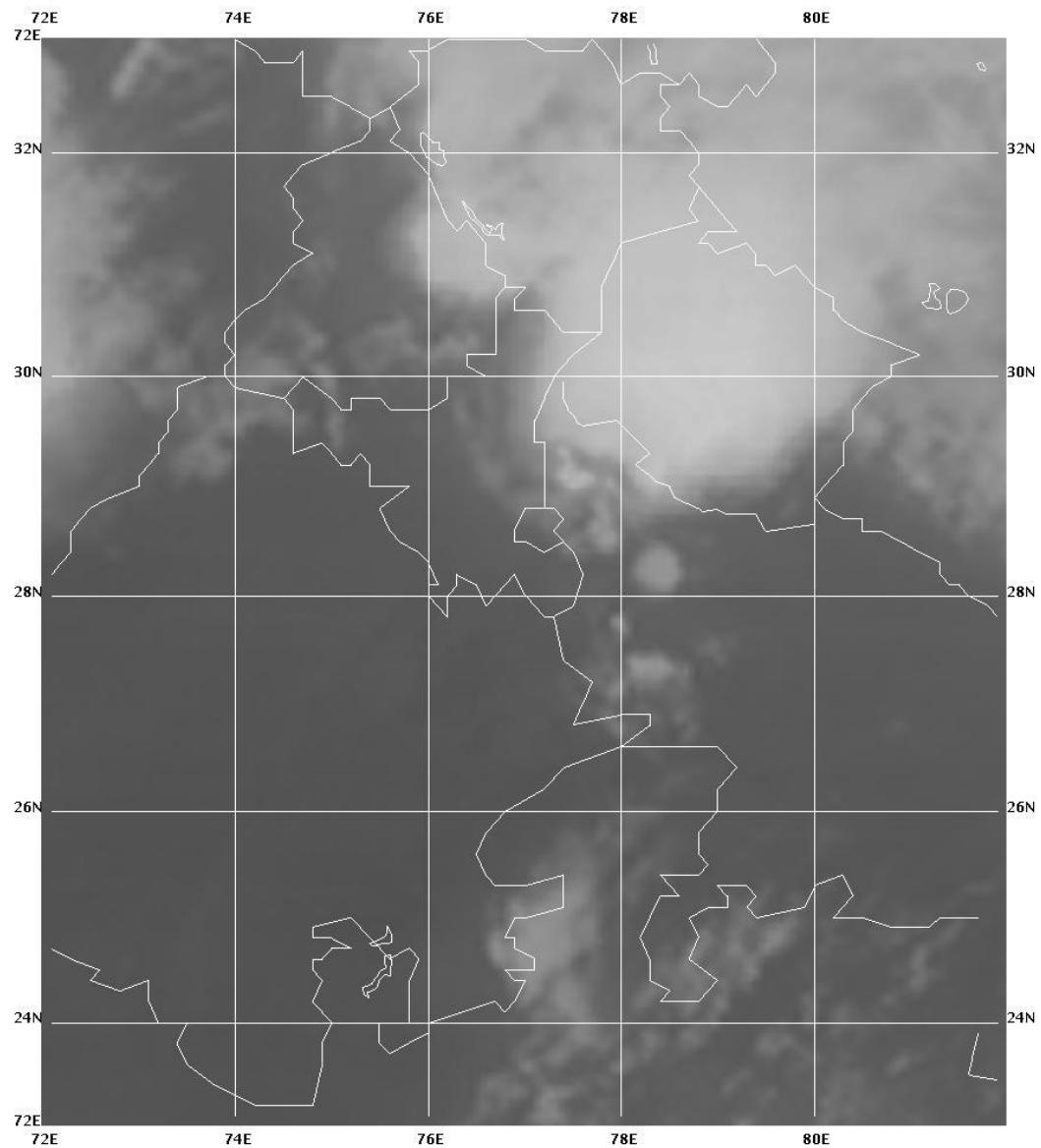
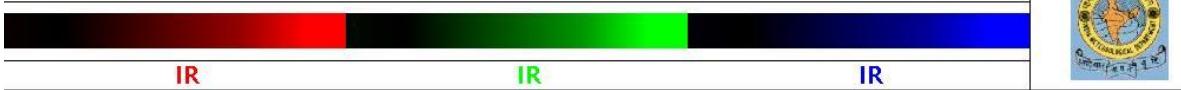
Sensor : VHRR

SAT : KALPANA-1

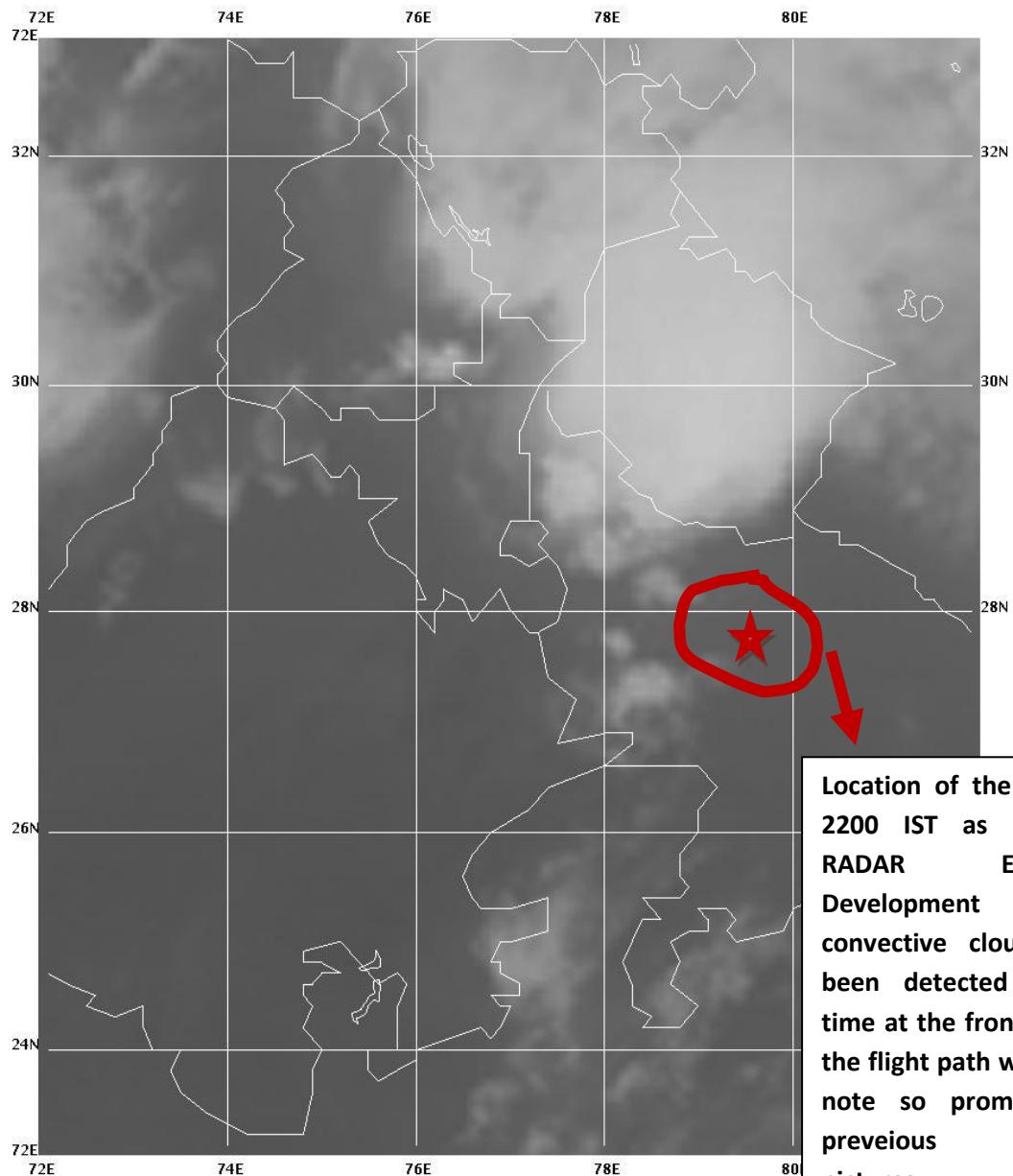
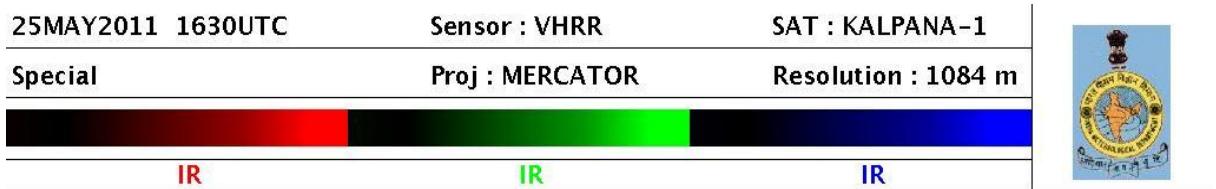
Special

Proj : MERCATOR

Resolution : 1084 m



**Fig 3c:** Satellite pictures of North India at 2130 IST



**Fig 3c:** Satellite pictures of North India at 2200 IST

25MAY2011 1700UTC

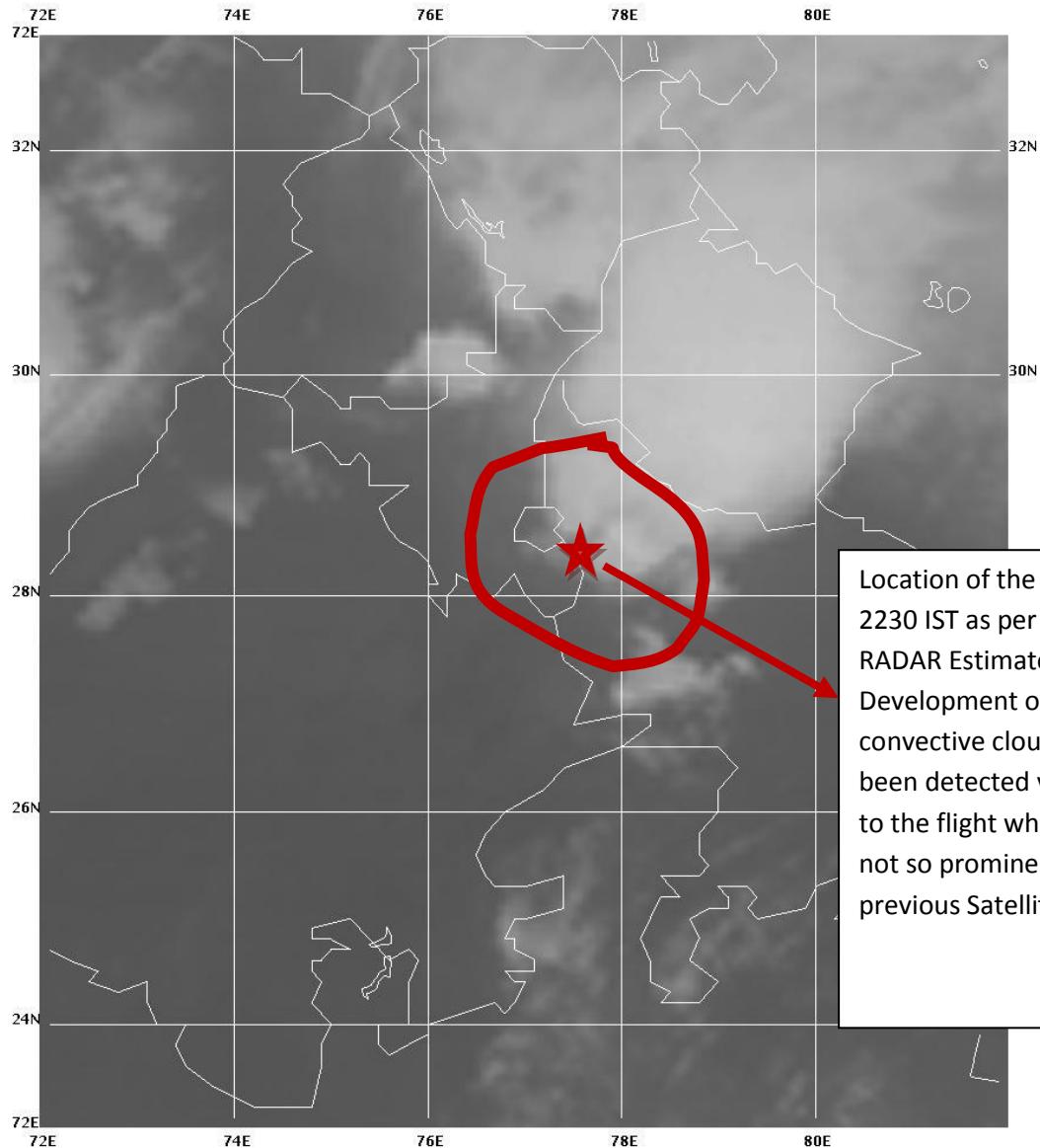
Sensor : VHRR

SAT : KALPANA-1

Special

Proj : MERCATOR

Resolution : 1084 m



**Fig 3d:** Satellite pictures of North India at 2230 IST

25MAY2011 1729UTC

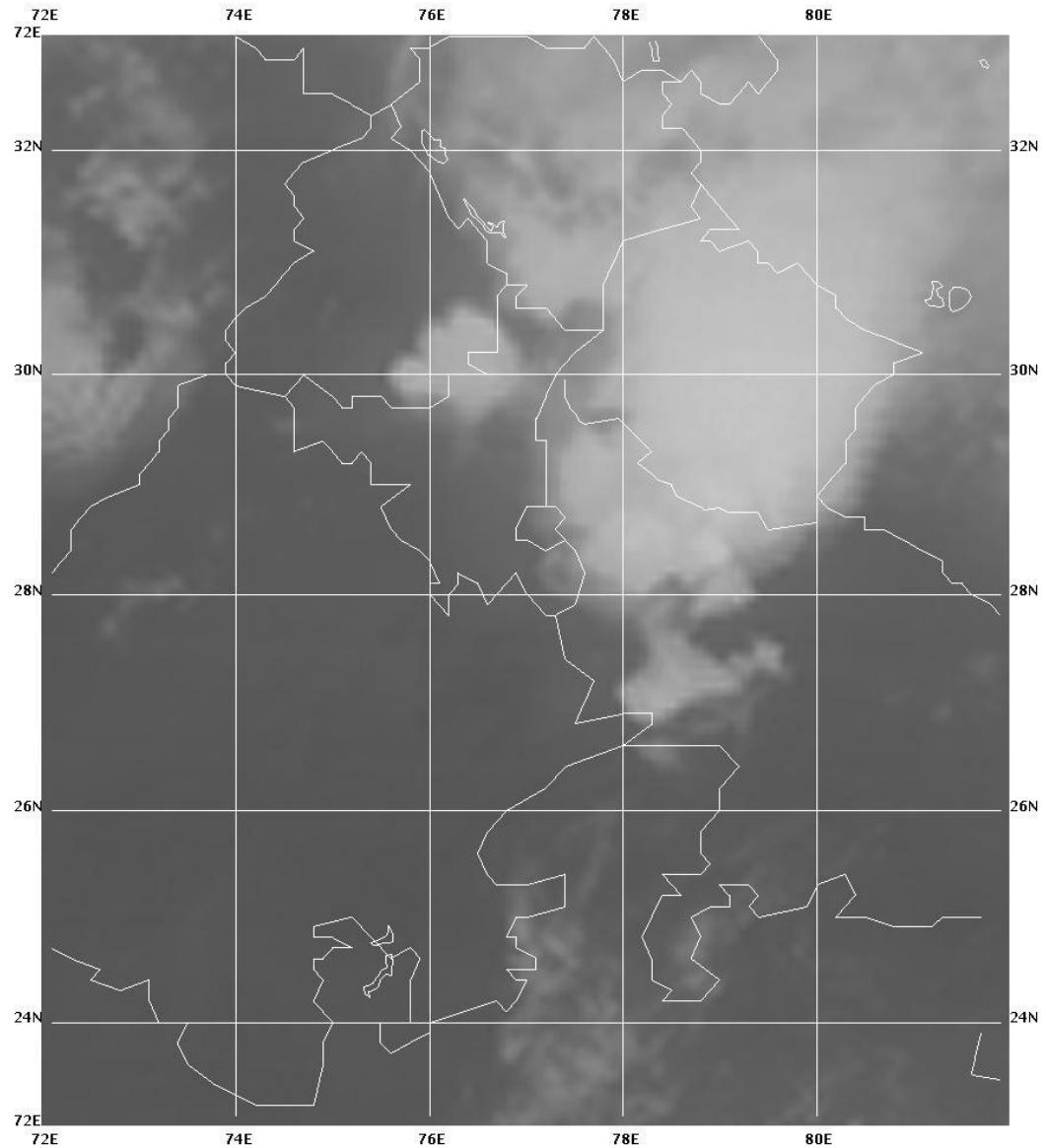
Sensor : VHRR

SAT : KALPANA-1

Special

Proj : MERCATOR

Resolution : 1084 m



**Fig 3e:** Satellite pictures of North India at 2259 IST

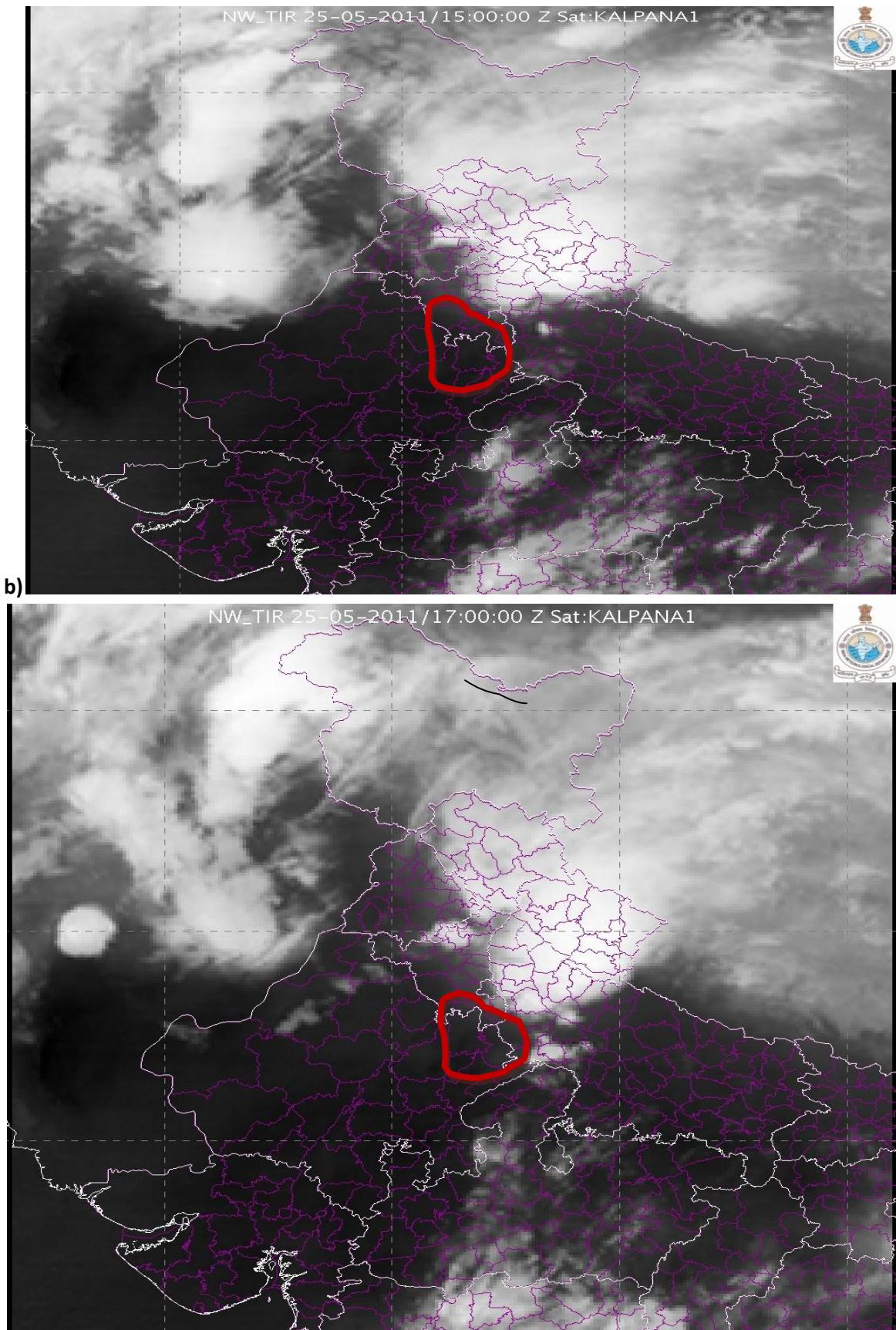
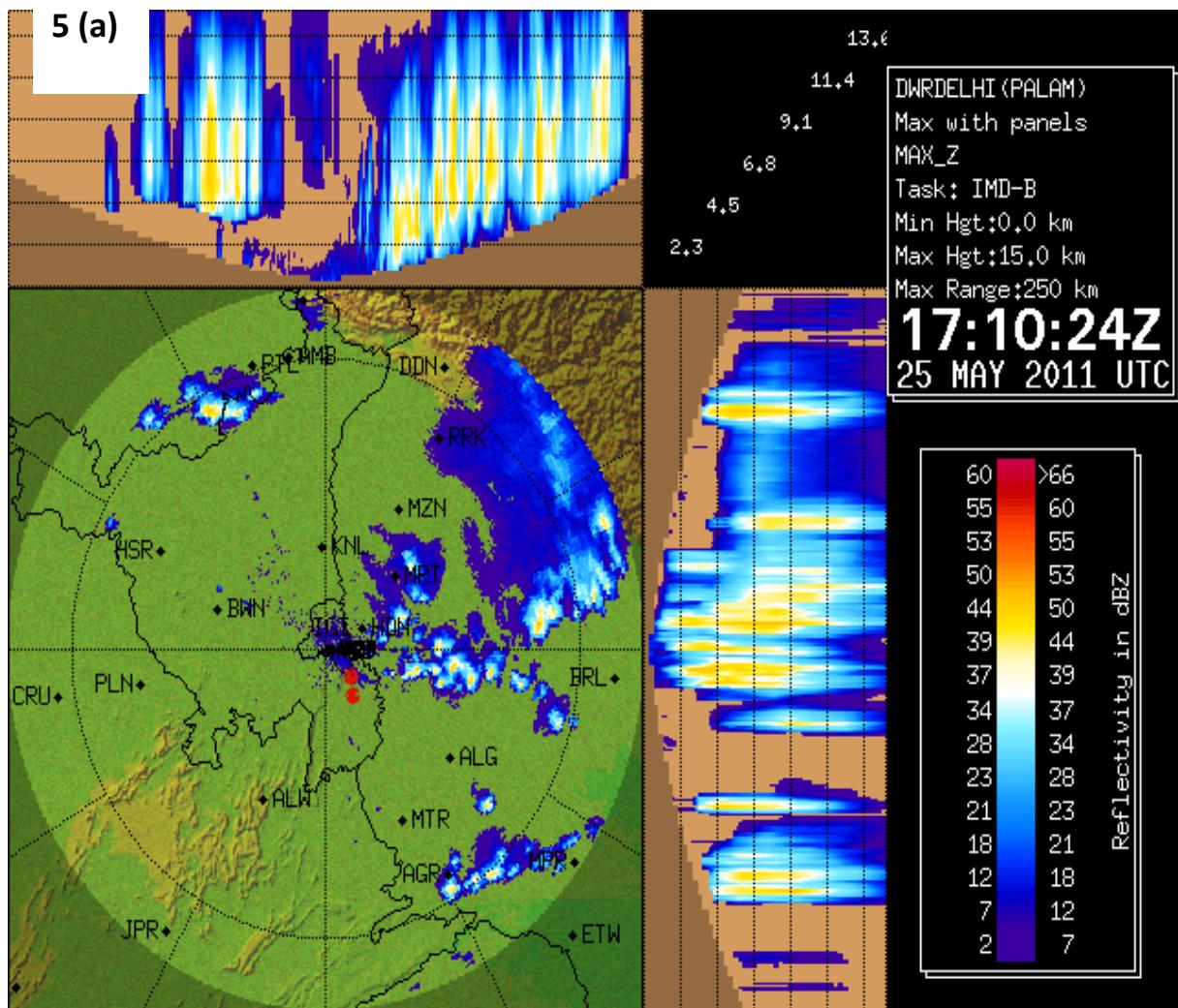
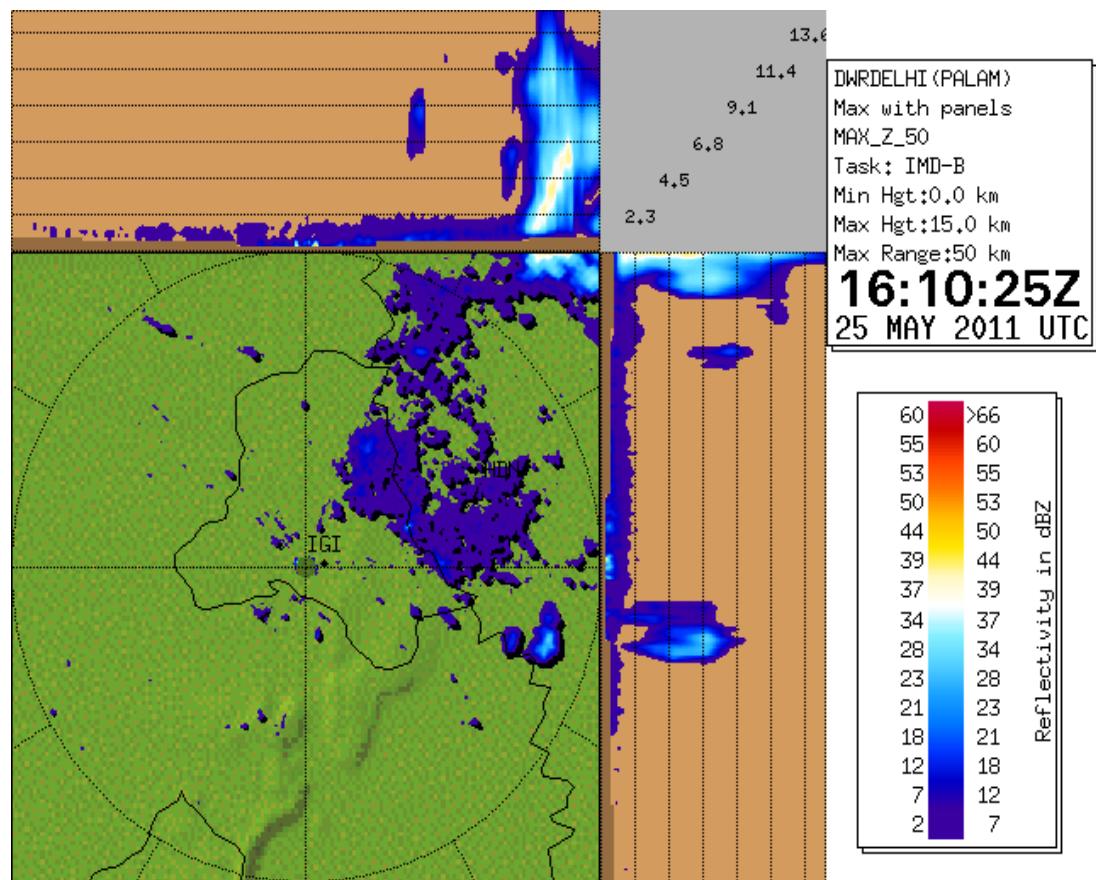


Fig. 4. a-b, District wise Satellite pictures of North India at 2030 and 2230 IST

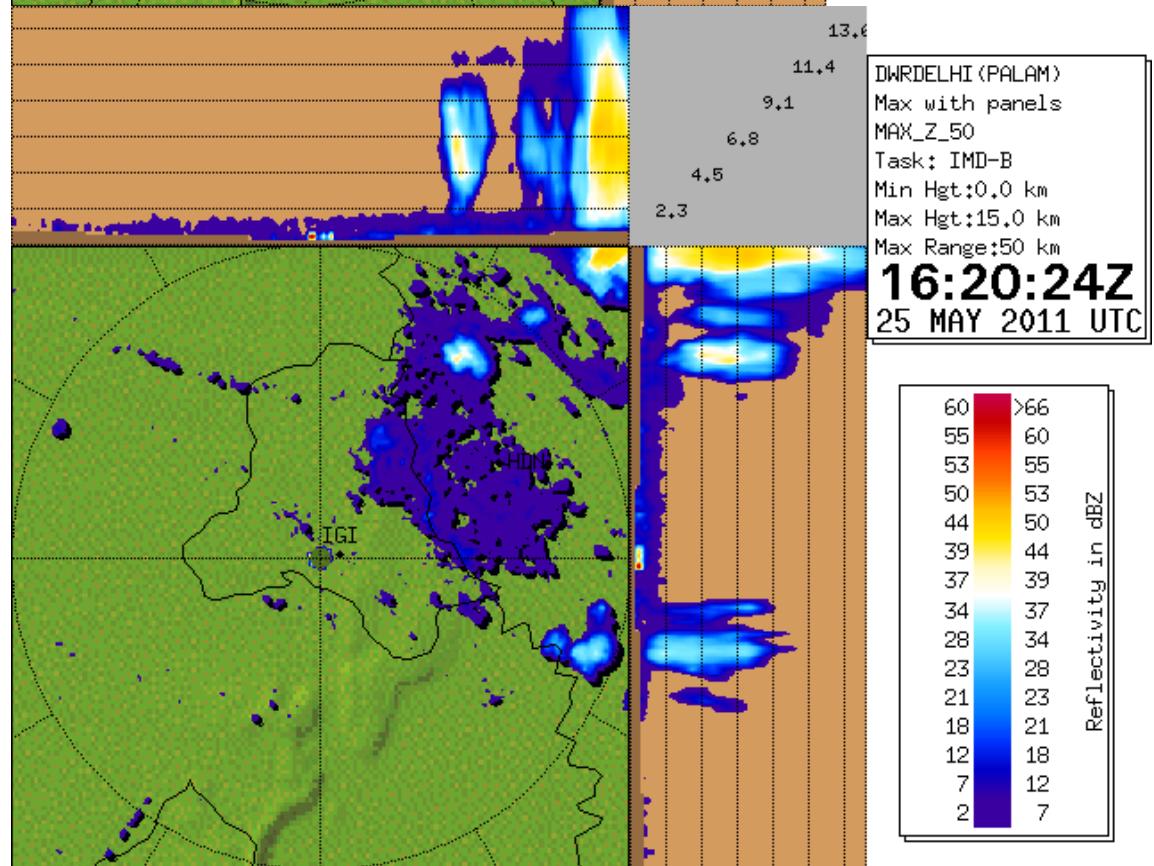


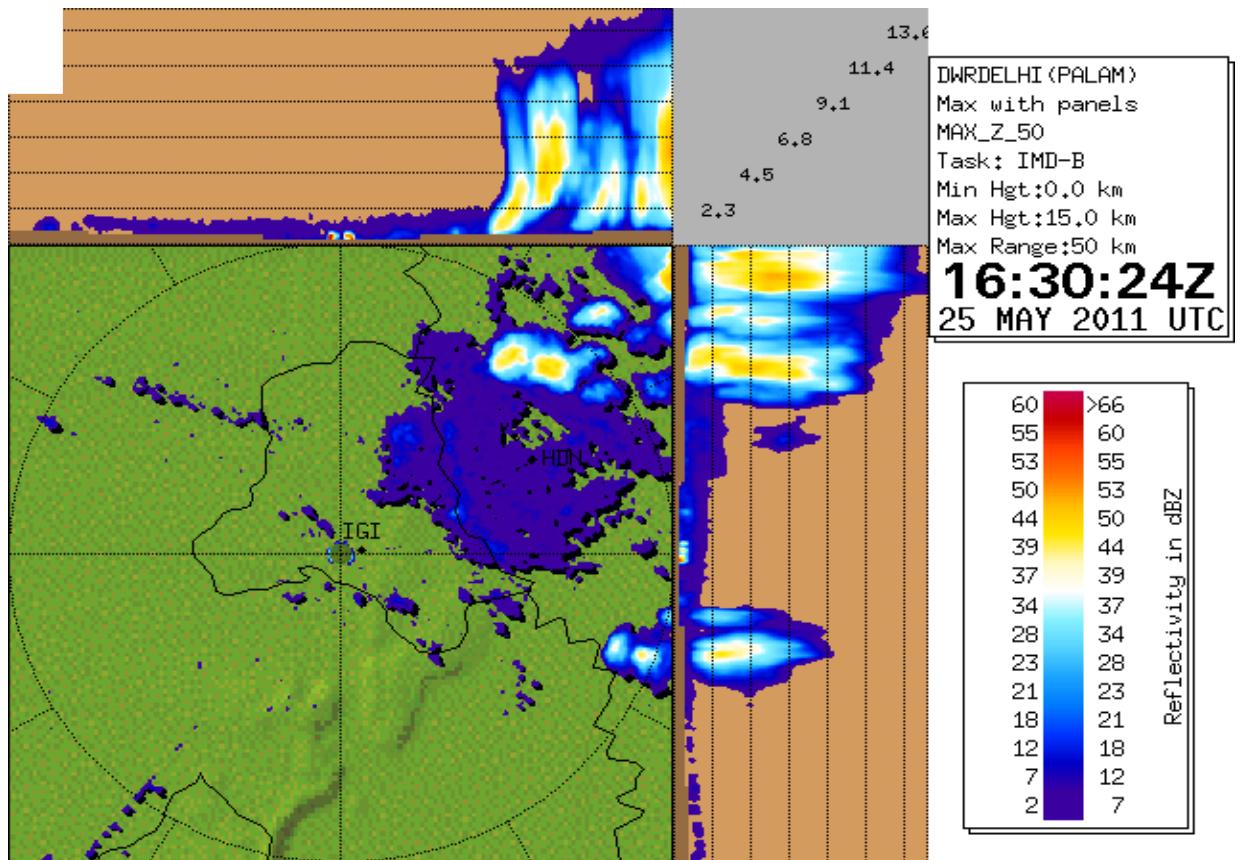
**Fig. 5(a-b).** 250km range DWR MAX Z cloud Pictures of the period with the Flight locations (ATC RADAR estimates received from ATC, AAI, during the period 2210-2240 IST

6(a)

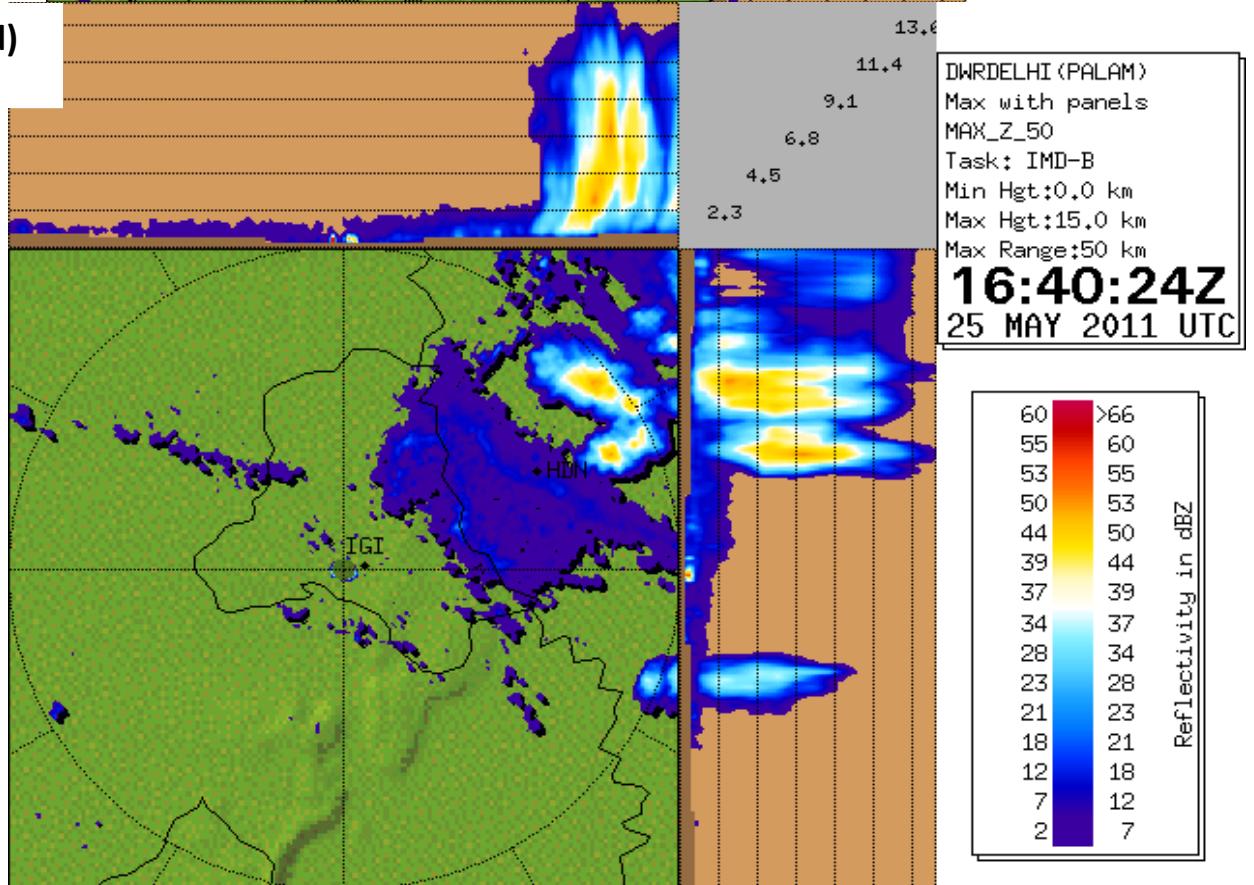


6(b)

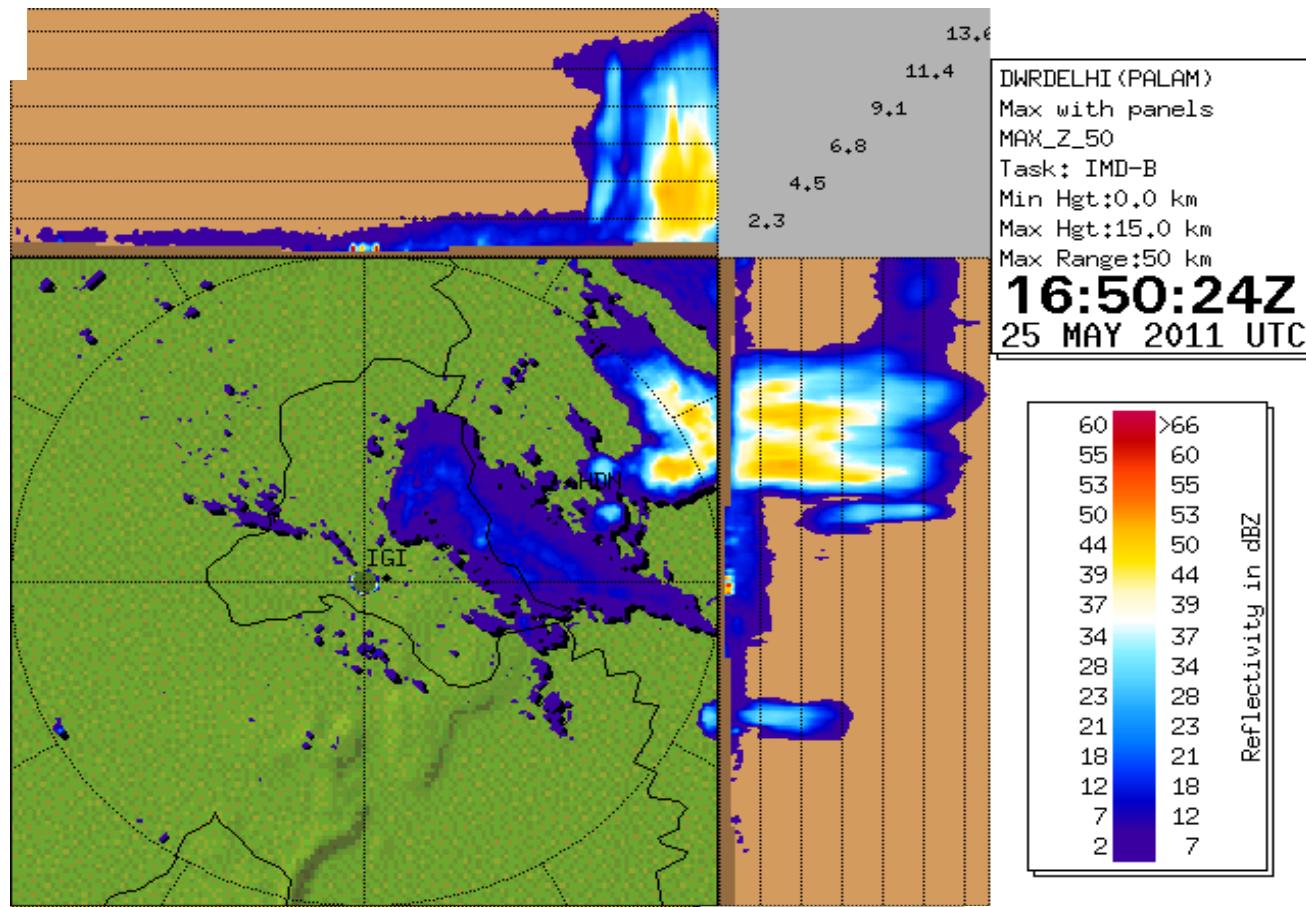




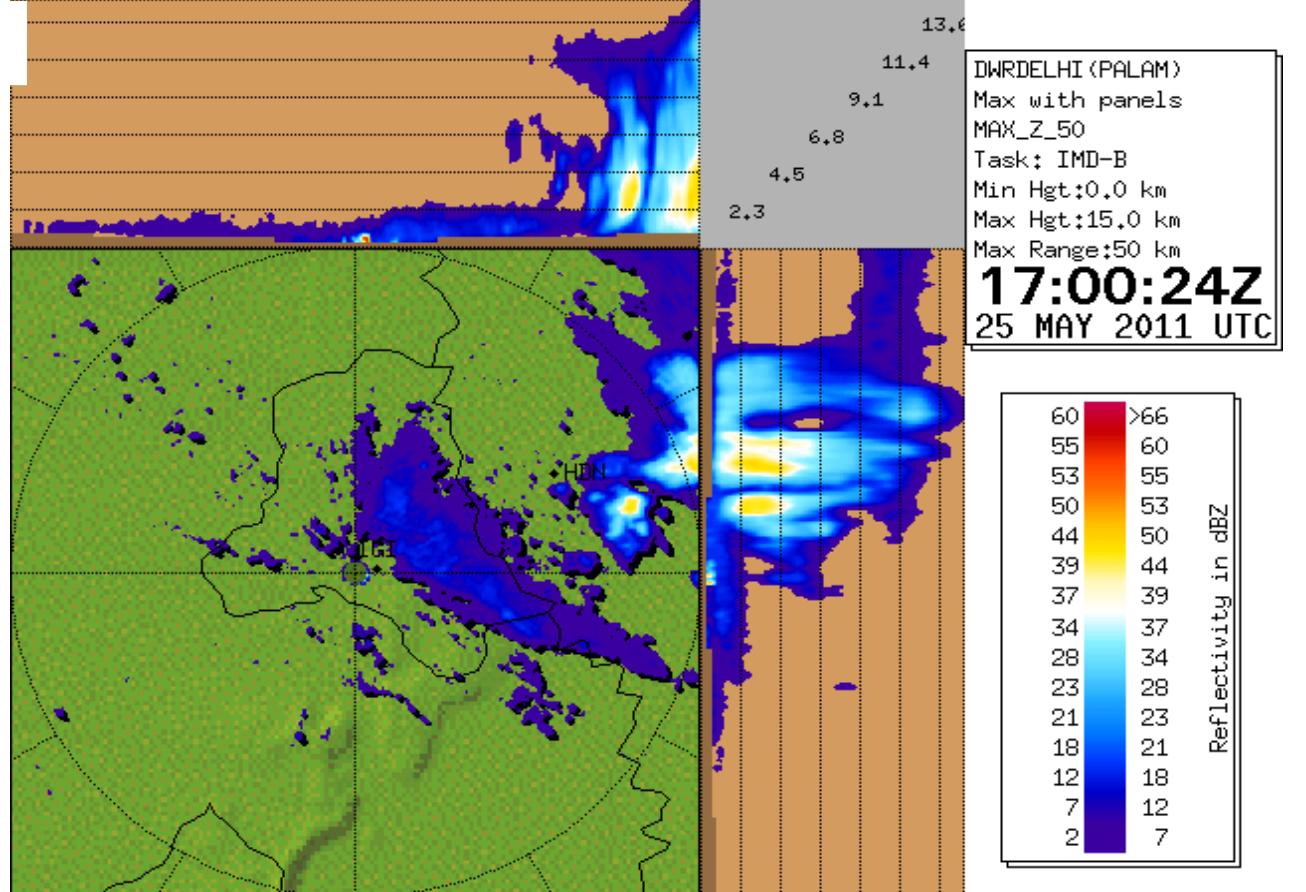
6(d)



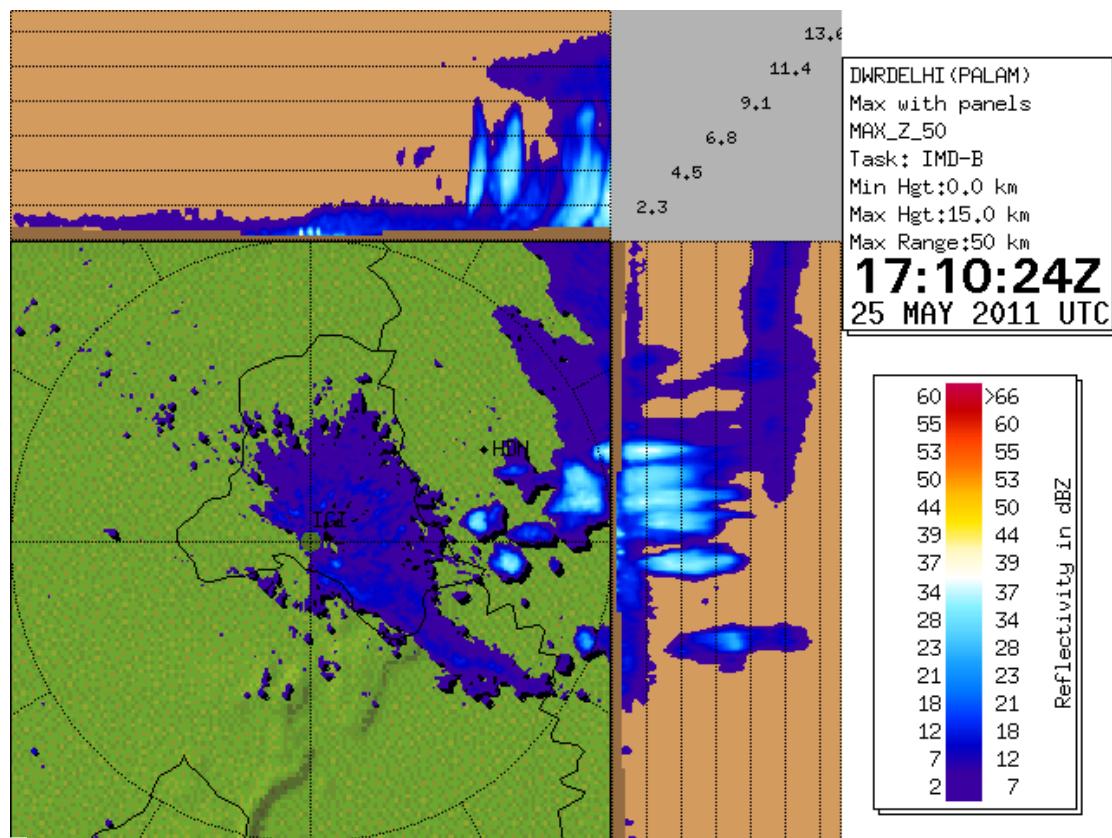
6(e)



6(f)



6(g)



6(h)

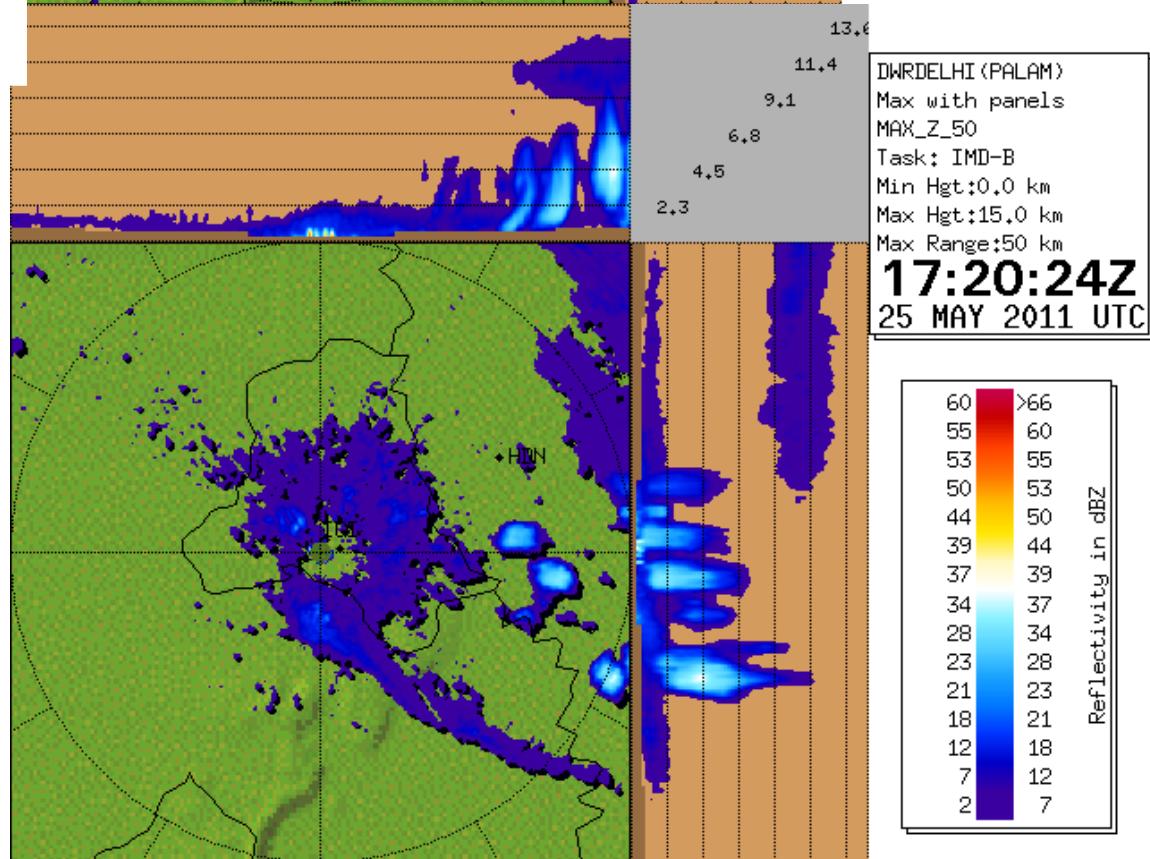
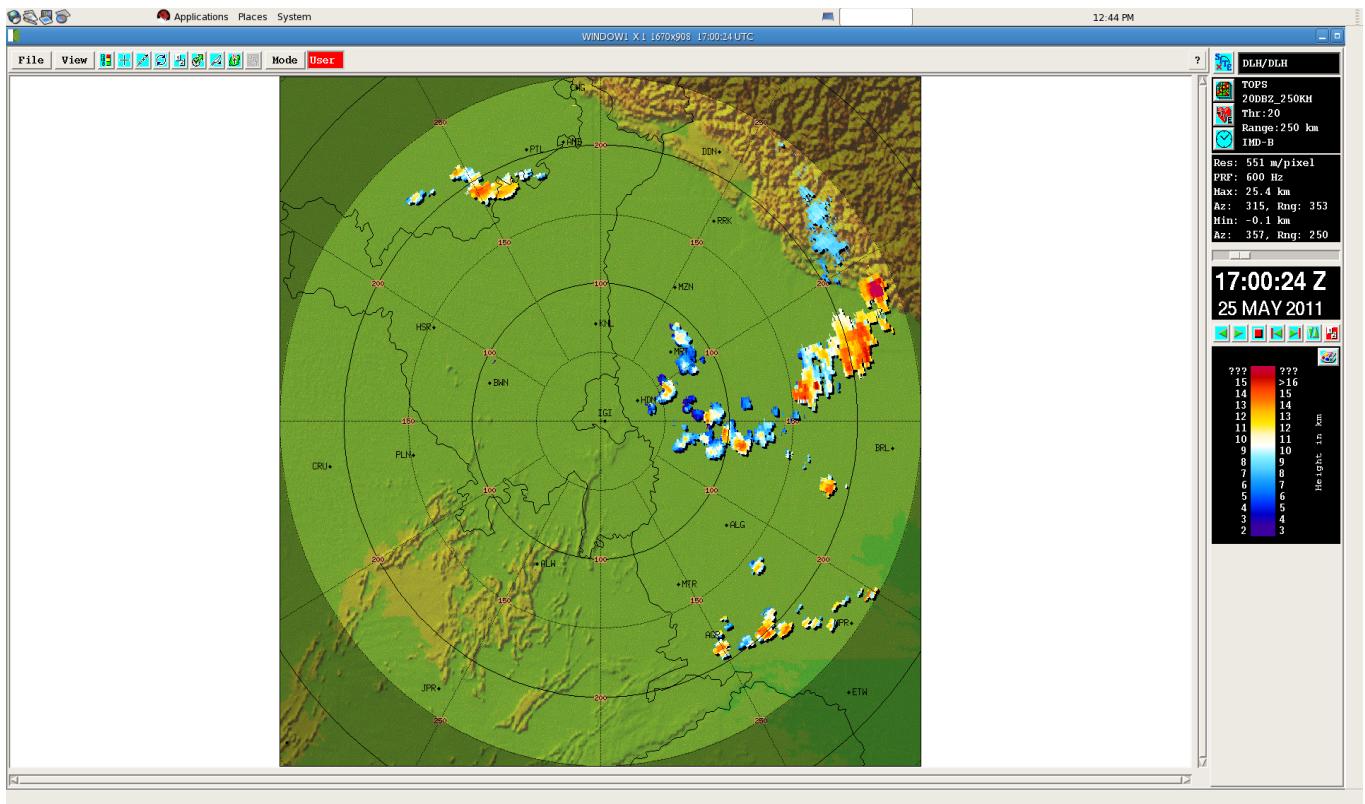
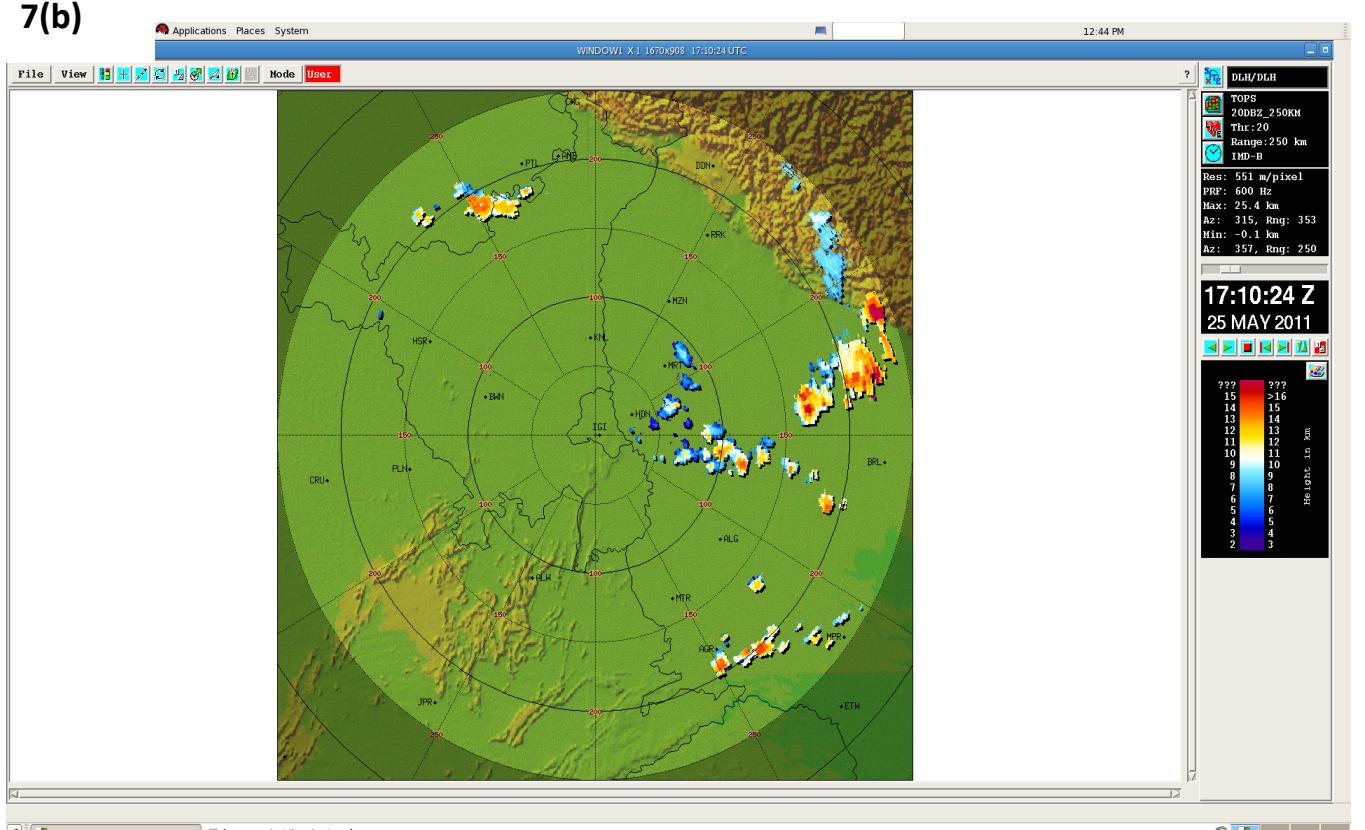


Fig. 6(a-h). 50km range DWR MAX Z cloud Pictures of IGI Airport for the period

**7(a)**

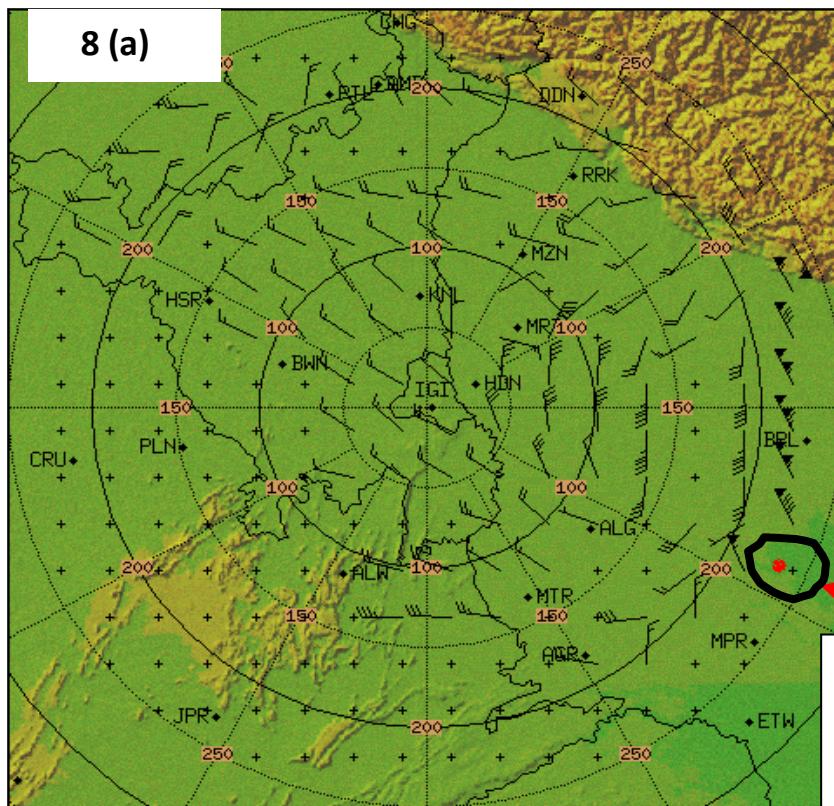


**7(b)**



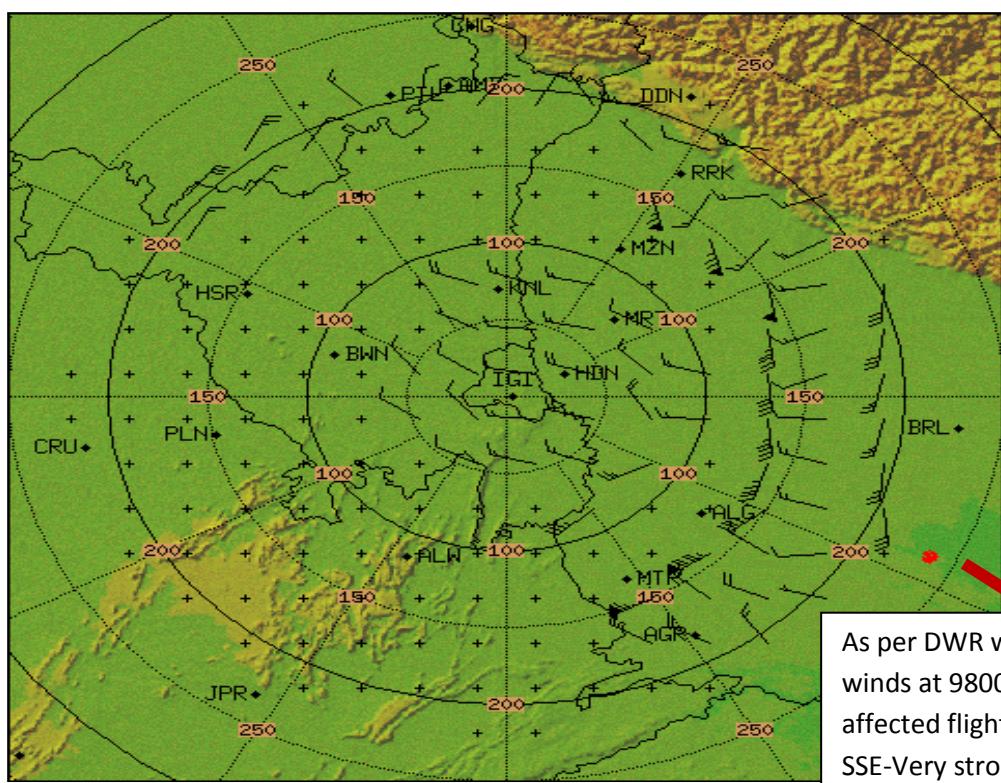
**Fig. 7(a-b) CLOUD TOPS FROM DWR shows it was extended upto 8-12km**

8(a)



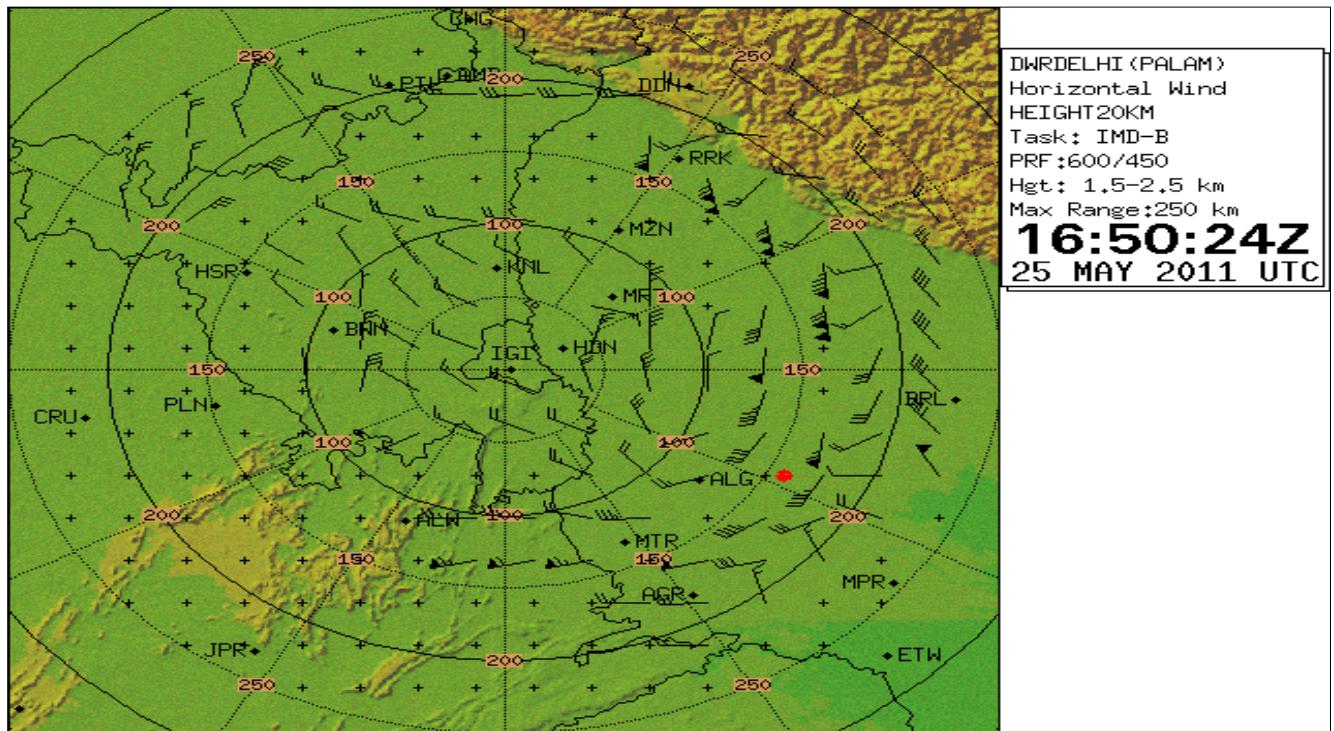
As per DWR wind estimations, the winds at 6500 feet agl near the affected flight was 70-90kts from NNW-Very strong turbulences

8(b)

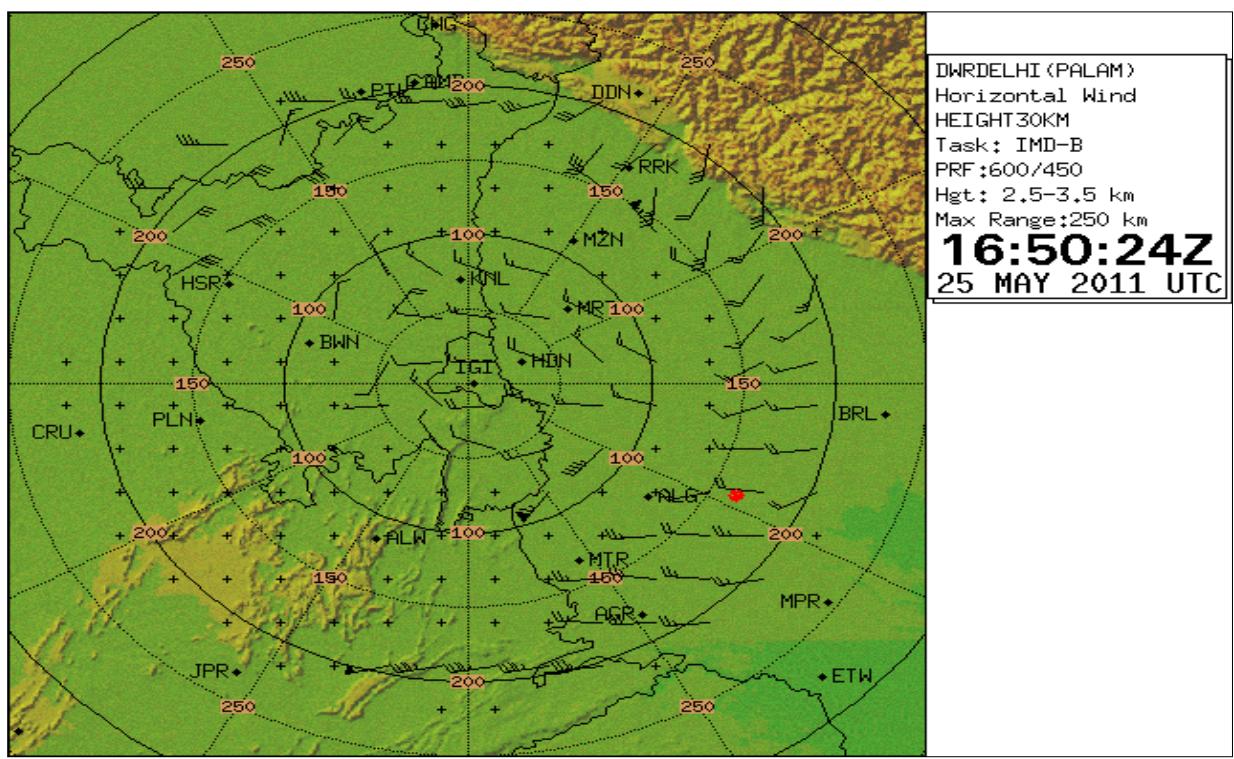


As per DWR wind estimations, the winds at 9800 feet agl near the affected flight was 30-50kts from SSE-Very strong turbulences

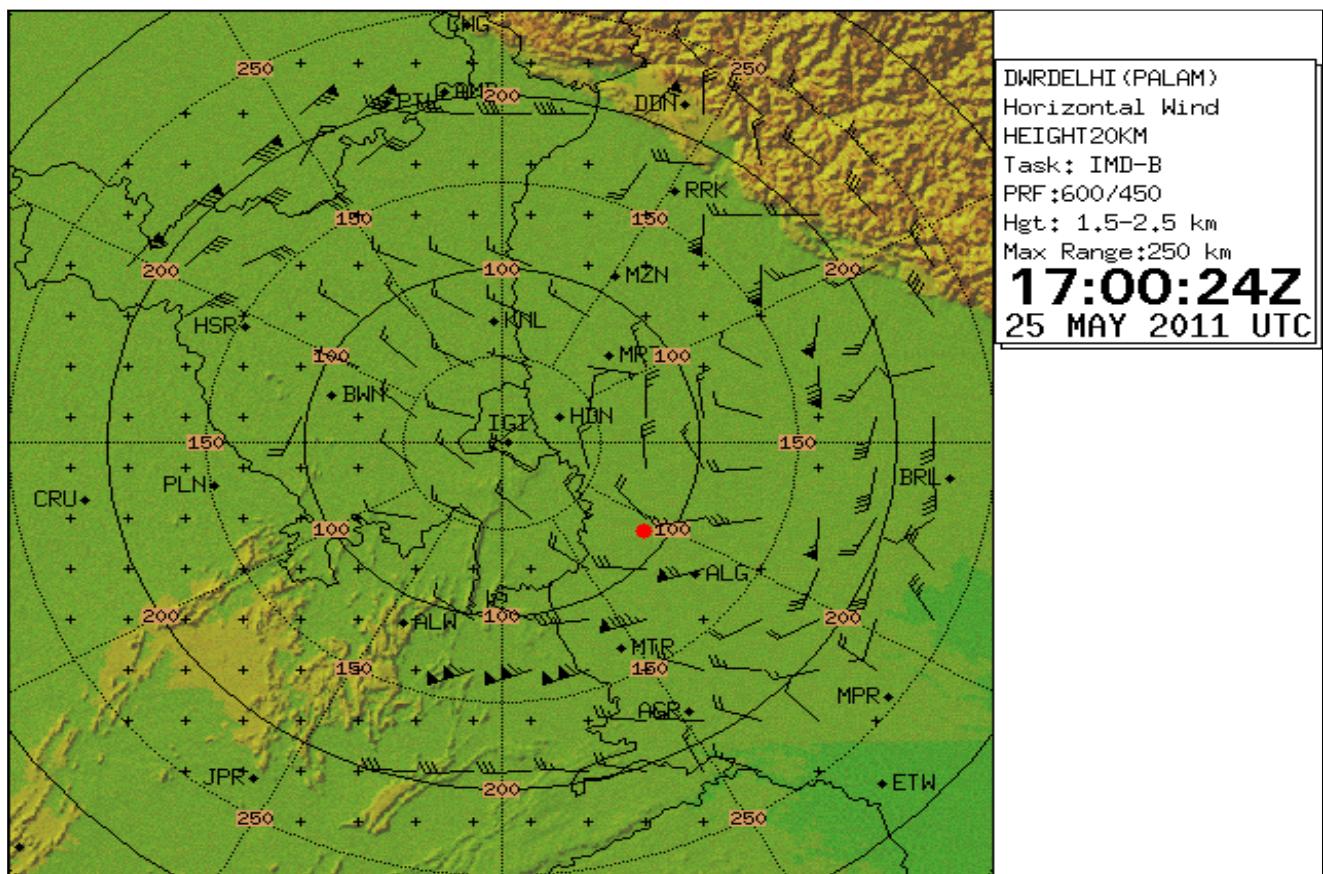
8(c)



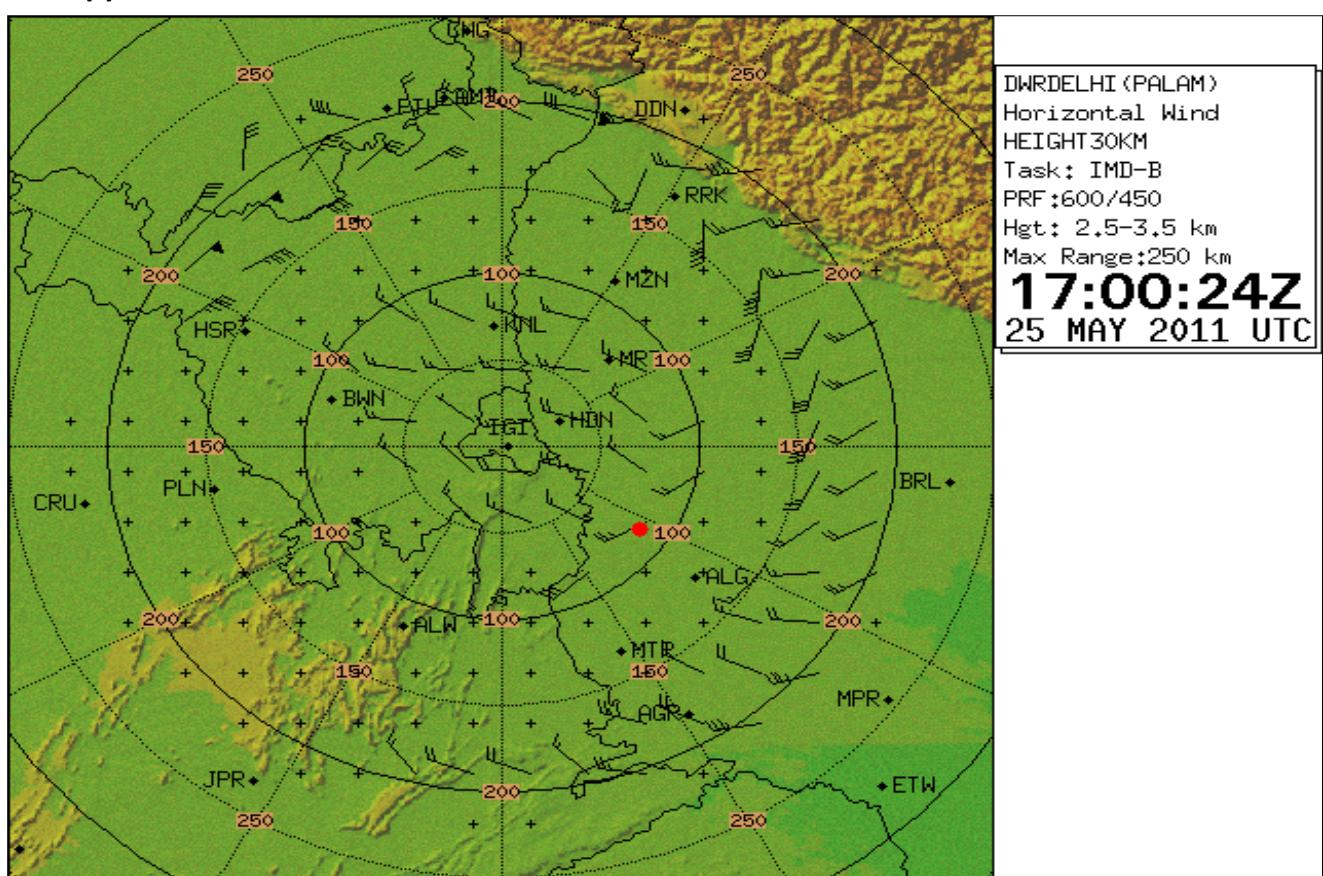
8(d)



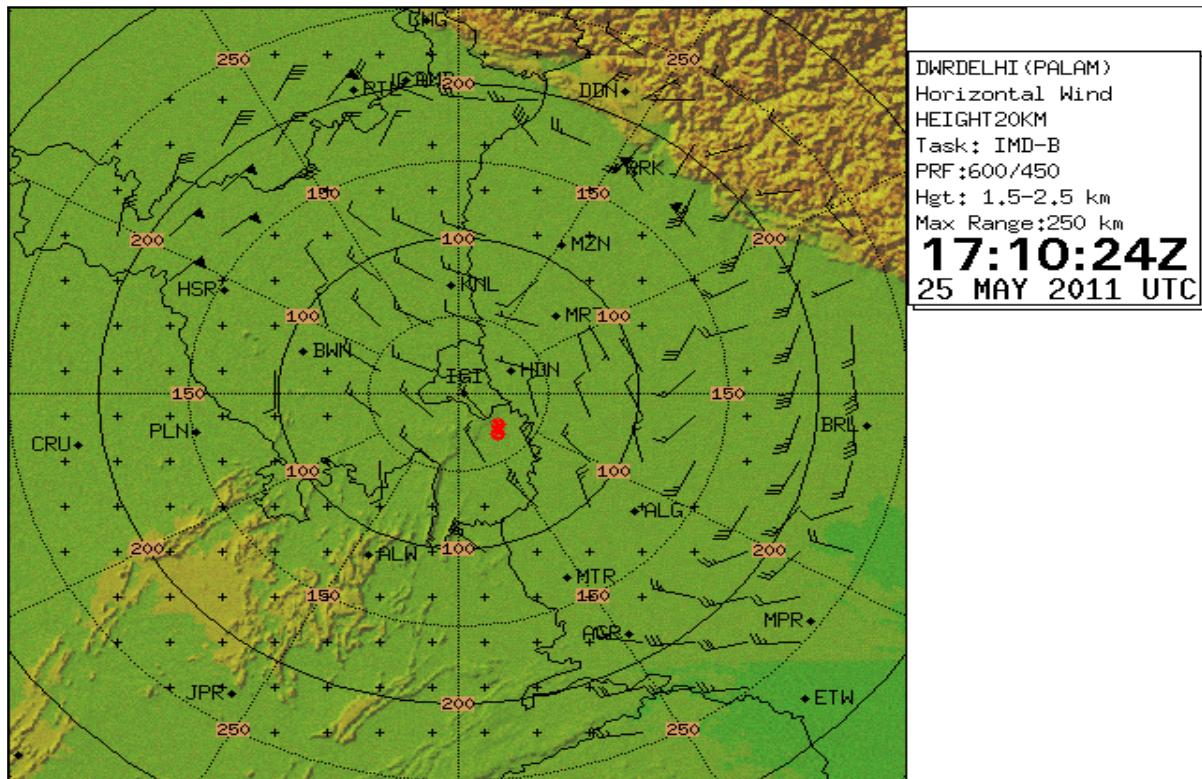
8(e)



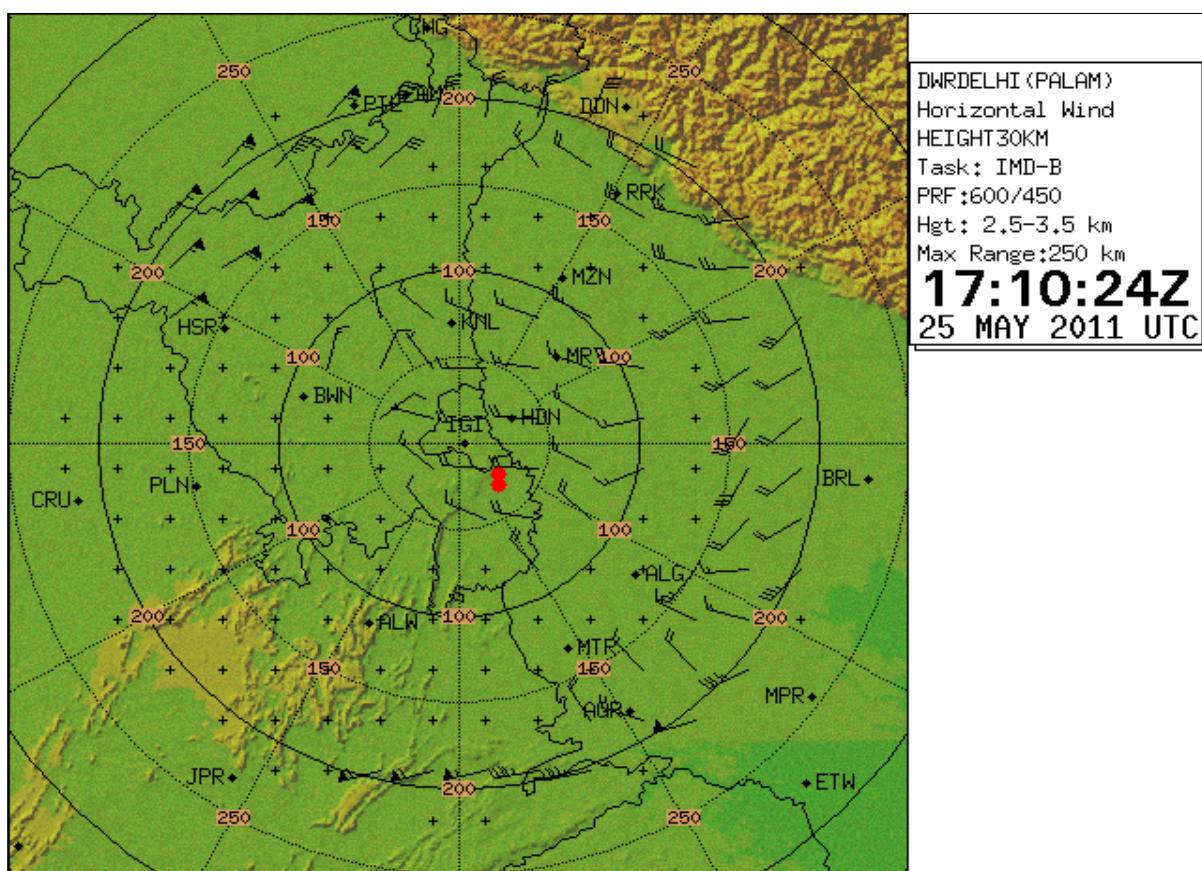
8(f)



8(g)



(h)



**Fig.8(a-h).** In (a), (c), (e)-as per DWR wind estimations, the winds at 6500 feet above ground level near the affected flight was 70-90kts from NNW and in b, d, f-As per DWR wind estimations, the winds at 9800 feet above ground level near the affected flight was 30-50kts from SSE-Very strong turbulences.