ACCIDENT TO SAHARA INDIA AIRLINES B-737-200 AIRCRAFT DURING THE TRAINING FLIGHT ON 8.3.1994 AT IGI AIRPORT, DELHI

REPORT OF

THE

COURT OF INQUIRY

HON'BLE MR. JUSTICE Y.K.SABHARWAL

JUDGE

HIGH COURT OF DELHI

ASSESSORS

1. Air Commodore R.P.S.Garcha
   Air Officer Commanding,
   Air Force Station, Palam,
   New Delhi

2. Mr.R.D.Thaku
   Deputy Director
   (Engineering),
   Indian Airlines
   (now General
   Manager(Engin-
   eering), Indian
   Airlines, Palam.

SECRETARY

Mr.J.S.Wazir
Senior Air Safety Officer
Office of the Director General
of Civil Aviation
New Delhi

New Delhi

22nd March 1995.

BROAD DETAILS OF THE ACCIDENT TO SAHARA INDIA AIRLINES B-737-200 AIRCRAFT DURING THE TRAINING FLIGHT ON 8.3.94 AT IGI AIRPORT, DELHI.

A.	Aircraft and Registration	B-737-200, VT-SIA
B.	Owner & Lessee	(a) Owner Mr.Stephan Grzimek GAC USA II INC.36, West 44th Street Messinger,New York (b) Lessee Sahara India Airlines, 7th Floor,Ambadeep, 14 Kasturba Gandhi Marg, Connaught Place, New Delhi.
C.	Operator	Sahara India Airlines
D.	Date & Time of Accident-	8.3.94 1454 hrs.IST
E.	Type of Operation	Training Flight (Circuits and landings)
F.	Phase of Flight	During the initial Climb
G.	Place of Accident	Apron II (International Terminal) Palam Airport, Near Bay No.46.
H.	Crew on Board	1.Capt.P.Khurana,Instructor 2.Pilot Trainee P.Singh 3.Pilot Trainee V.Mahajan 4.Pilot Trainee Anshu Khurana.
I.	No.of persons Killed	9 which include 4 crew members of Sahara India Airlines, 4 personnel of Aeroflot and 1 Bharat Petroleum Contractor.

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INTRODUCTION

This unfortunate crash is different than most of the earlier ones since here it happened during a training flight and not during a regular revenue earning flight.

Sahara India Airlines (henceforth referred as 'Sahara') Boeing 737-200 Aircraft (VT-SIA) on a local training flight at Delhi Airport on 8th March, 1994 crashed at about 2.54 PM when it was in the process of executing the sixth circuit after uneventfully completing the fifth touch and go exercise. The crash resulted in death of 9 persons of which 3 were trainee pilots viz. Pramod Singh, Vidul Mahajan and Ms.Anshu Khurana who lost their lives at the prime of their youth at the very threshold of entering the professional career as Pilots. Capt.Parveen Khurana the Instructor on the illfated flight also lost his life.

It was the first training flight of Sahara for 3 young trainee pilots on Boeing Aircraft. It was also the first flight of Capt.Khurana as an instructor. It was also the first such crash during training flight organised by a Air Taxi operator in India.

Apart from the aforesaid four persons, four Aeroflot personnel also lost their lives as a result of

this crash on account of the wreckage of the Sahara aircraft ploughing through the Aeroflot IL-86 Aircraft parked nearby. One employee of Bharat Petroleum also lost his life.

The impact of the aircraft resulted in a fire which completely destroyed both the Aircraft. There was also extensive damage to at least two Aerobridges. Some other items on ground which were in the vicinity also suffered extensive damage.

Soon after the accident, Mr.V.K.Chandna, Director of Air Safety, was appointed to act as Inspector of Accidents under Rule 71 of the Aircraft Rules 1937 (the Rules). The Government of India also directed that a formal investigation of the accident be held as stipulated by Rule 75 and appointed me to function as the Court in terms of Notification dated 6th May, 1994.

Air Commodore. R.P.S. Garcha, Air Officer Commanding, Air Force Station, Palam, New Delhi, and Mr.R.D.Thakur, Deputy Director (Engineering), Indian Airlines, New Delhi, (now General Manager, Engineering), Indian Airlines, Palam, were appointed to act as Assessors for the investigation. Mr.J.S.Wazir, Senior Air Safety Officer, Office of the Director General of Civil Aviation, was appointed to function as

Secretary to the Court.

In the report not only the finding as to the causes of the accident and circumstances thereof are required to be stated but any observations and recommendations which the Court may think fit are also required to be made for preservation of life and avoidance of similar accidents in future.

On 13th May 1994, Mr.H.S.Khola, Director General, DGCA, along with Mr.Satinder Singh, Deputy Director General, Mr. V.K.Chandna and Mr.J.S.Wazir met me and briefed me about the accident and the investigation that had been carried out upto that time. During this briefing I was also informed that Cockpit Voice Recorder (CVR) and Universal Flight Data Recorder (UFDR) had been retrieved and preserved for the investigation purposes.

On 18th May, 1994 the first meeting with the Assessors was held which was also attended by Mr.Khola, Mr.Satinder Singh and Mr.Chandna. A general discussion on aircraft details, flying training syllabus, Pilot training details, experience, profile etc. took place and it was decided that the crash site and wreckage would be inspected on 20th May, 1994.

On 20th May, 1994, I along with the Assess... and aforesaid Officers and Mr.Harbans Kumar, Airport Director, visited the crash site and inspected the wreckage at Indira Gandhi International Airport. At crash site the impact marks and other ground marks indicating the direction of the flight at the time of impact were shown and explained to us by Mr.Chandna. He also told us broad facts about the spread of the disintegrated parts of the Sahara Aircraft and how the said parts had hit the parked Aeroflot Aircraft and caused the destruction and the subsequent fire. We also visited Sub Fire Station II and it was explained that the fire fighting and rescue staff from the said Fire Station was the first to respond to the crash. The wreckage of the two aircraft placed near International Cargo Complex was also inspected.

On 23rd May, 1994, I again visited the Airport along with the Assessors to observe the functioning of various B-737-200 aircraft systems relevant for the purposes of further investigation of the accident in question. The functioning of the various aircraft systems and controls of Boeing aircraft were explained to me. The Air Traffic Control was also visited where Director of Aerodrome, NAA explained the duties and functions of various personnel working in the Air Traffic Control units including the facilities and

equipments for recording the Air Traffic Conversations.

On 25th May, 1994, accompanied with Assessors I visited the Office of DGCA for hearing conversation on CVR. Regarding the horn sound in CVR Mr.Satinder Singh explained that the same can be subjected to spectrum analysis and compared with the known spectrum of various warning sound/horns for identification. I also inspected the UFDR and found it to be in a damaged condition. It was partly burnt.

I was informed that Director General had constituted a group comprising of Mr.N.M.Moorti, Assistant Director from National Aeronautic Laboratory, Group Captain Mr.C.Chandrasekharan, VSM (Retd.) of VSM Aerospace, Mr.P.M. Ramachandra, Officiating Engineering Manager, Air India and Mr.V.K. chandna to study various alternatives for recovery of data from the damaged UFDR retrieved from the accident site. On considering the recommendations of the said Group as contained in their report dated 13th March, 1994 and after discussion with Assessors, I directed that the condition of the tape shall be seen at the Laboratory of Air India at Bombay and depending upon the condition of the tape it will be decided, whether it was possible or worthwhile to retrieve the data in India or the UFDR was required to be sent abroad. I further directed that manufac-

turer of UFDR should be informed about our intentions to open the Unit in India so that they may send a representative in whose presence the Unit may be opened and data retrieved, if possible. The manufacturer, however, did not opt to send a representative. All the four persons constituting the Group that had given the report dated 13th March, 1994 were directed to be present at the Laboratory of Air India, Bombay. It was decided that in the Laboratory of Air India at Bombay, first the cover will be removed from the casing of UFDR and if the tape inside show any sign of damage, a decision will be taken on the spot for taking the Unit abroad.

The UFDR was opened at the Laboratory of Air India at Bombay with the assistance of experts from Air India and VSM Aerospace, Bangalore. On opening the UFDR it was observed that electronics of the Unit had been damaged to some extent but the Capsule containing the UFDR tape appeared to be undamaged. On the opening of the Capsules it was found that the driving motor was jammmed and it was, therefore, replaced with a serviceable motor. The data from the tape was dumped on a casettee. I directed Mr.Chandna to take the casettee to VSM Aerospace, Bangalore, for getting the print out. Air Commodore Garcha was also requested to accompany Mr.Chandna. The decision to transfer the data was taken after observing the satisfactory condition of the

capsule assembly. It was explained to me that some of the data, in the print out taken at VSM Laboratory, Bangalore, was erratic and needed careful study. After discussion with the Assessors and DGCA Officers I directed that to clarify the erratic data, first an attempt should be made at National Aeronautical Laboratory, Bangalore, and it is only thereafter a decision can be taken whether it is necessary to have the assistance for the analysis of the data from National Transport Safety Board, Washington or not.

I directed that public notice should be issued in the main newspapers, one of which should also be in a vernacular language latest by 10th June, 1994 requiring any person having direct or relevant knowledge or information about the accident or the causes or circumstances leading to the said accident or who may or is likely to be affected by the finding of the Court of Inquiry to furnish statement in writing along with an affidavit to the Court of Inquiry. In terms of these directions the public notice was issued in leading newspapers on or about 7th June, 1994.

To study various aspects, four different groups were directed to be constituted. They were:-

1. Control Group.

2. Engine Group.

3. Explosive Group.

4. Fire Fighting Group.

Reference to the reports of these groups has been made in the report of Inspector of Accidents.

For taking out the UFDR data print, the NAL, Bangalore was visited on 25th June, 1994. Before start of the work I directed the Officers to ensure that the tape does not suffer any damage while conducting the replay. It was duly adhered to. The print out showed that some of the data was still erratic. Mr.Satinder Singh and Mr.Chandna were asked to carry out the UFDR data study.

In a meeting held on 2nd July, 1994, which was attended by the Assessors as also by Mr.Khola, Mr.Satinder Singh and Mr.Chandna, it was explained that some of the data was erratic and since we have reached the dead end of our capabilities and, therefore, it was advisable to approach NTSB, USA for analysis of the UFDR data. The matter was taken up by Mr.Chandna and Mr.Wazir with NTSB and they agreed to render all assistance.

The first pre-conference hearing was held on 12th July, 1994 which was attended by counsel for

Sahara, DGCA and NAA. The report of the Inspector of Accidents was not ready. The report was likely to be delayed as Mr.Chandna, it was explained, was also investigating as Inspector of Accidents of a recent accident of an Aircraft in which the Governor of Punjab and his family members had died. The counsel were informed that after the submission of the report, they could file supplementary affidavits and also that they will be informed about the date of next pre-hearing conference.

On 15th July, 1994 during discussion at CTE, Hyderabad, Capt.Shamsher Singh an Instructor of Indian Airlines at the said Training Centre explained that when a Check Pilot is firstly approved as Instructor, he has to train two batches of trainees successfully on simulator under supervision of an Examiner / Senior Instructor and then he will take instructions on simulator alone. If the Examiner / Senior Instructor is satisfied, then the instructor will be allowed to take the trainees on actual aircraft under observation of a Senior Instructor / Examiner. After the above and only after his performance has been adjudged satisfactorily, then alone the instructor will be allowed to take the students independently on instructional flight on aircraft and all this was as per the Training Manual of Indian Airlines. Some exercises on simulator at Hyd-

erabad Training Centre were also undertaken.

In pre-hearing conference held on 9th August, 1994 the Court gave participant status to the following:-

1. International Airport Authority.
2. National Airport Auithority.
3. Sahara India Airlines.
4. Aeroflot.
5. Boeing.
6. Director General of Civil Aviation.

Copies of the report of the Inspector of Accidents dated 5th August, 1994 were given to counsel for the partries who had been given the participant status. They were directed to file detailed submissions alongwith (i) Affidavits; (ii) Documents on which they want to rely; (iii) List of witnesses they want to examine with affidavits of witnesses. With consent of parties it was directed that affidavits of witnesses will be treated as their examination-in-chief. The parties were directed to file affidavits and documents within a period of 5 weeks and it was directed that in the next pre-hearing conference the list of witnesses will be finalised and further schedule including the commencemdent of public hearing and recording of oral evidence, if any, will be fixed. In the pre-hearing conference held on 10th September,

1994, Mrs.Anita Khurana, wife of Capt.Parveen Khurana on consideration of her application was granted participant status. In this conference I also directed Sahara to submit the status of compliance of AD issued by FAA and Boeing service letter dated 13th July 1993 in respect of Power Control Units. The DGCA was also directed to file statement of training being imparted by Indian Airlines for the training pilots before permitting them to fly regular flights including the requirements to be met before an instructor starts imparting flying training and also state whether before exercising privileges an instructor is checked by DGCA or not. The next pre-hearing conference was fixed for 17th October, 1994. I along with Mr.V.K.Chandna and Mr.J.S.Wazir for the purpose of further analysis of UDFR data and get first hand information of training etc., visited USA, UK and Frankfurt, Germany between 23rd September, 1994 and 8th October, 1994. The UFDR data was further analysed at NTSB, Washington, USA. The British Calidonian at Gatwich, London, U.K. where training pilots had simulator training was visited so also the Heathrow Airport to have the first hand knowledge of fire fighting operations. In Frankfurt, the Lufthansa Centre for Training where Capt.Khurana had part of training as Instructor, was visited as also fire fighting operations at the Frankfurt Airport.

In the pre-hearing conference held on 17th October, 1994 the vital aspects to be examined in the inquiry were determined as, (i) System failure and/or (ii) Crew error; and/or (iii) Regulatory and Control functions of DGCA, NAA and IAAI. The list of witnesses was also drawn with the assistance of counsel for the parties. It was directed that recording of oral evidence will commence from 7th November, 1994 and it will continue from day to day. The order in which the witnesses will be examined was decided in pre-conference hearing on 2nd November, 1994. The oral evidence of 13 witnesses was recorded between 7th November, 1994 till 24th November, 1994 and thereafter written submissions were filed by counsel for the parties and the oral arguments were heard. The participants were represented by lawyers as under:-

1. Air Commodore N.A.K.Sarma(Retd) for N.A.A.
2. Mr.Lalit Bhasin for I.A.A.I.
3. Mr.Robin Mitra with Mr.D.K.Sarkar for Sahara.
4. Mr.R.K.Anand with Mr.Munish Malhotra for DGCA.
5. Mr.R.S.Suri with Mr.T.Topgay for Boeing.
6. Mr.Alok Mahajan for Mrs.Anita Khurana.
7. Mr.P.P.Malhotra with Mr.Yogesh Malhotra for Aerofloat.

1. FACTUAL INFORMATION

1.1 HISTORY OF FLIGHT

On 8.3.94, Sahara India Airlines operated the flight No.S2-003/004 (Delhi-Bangalore-Delhi) on B-737-200 VT-SIA Aircraft. The aircraft had departed Delhi at 0655 hrs (IST) and returned back at 1320 hrs (IST). After this flight the aircraft was to carry out training flight. Three pilot trainees (Mr.Pramod Singh, Mr.Vidul Mahajan and Miss Anshu Khurana, all Commercial Pilot Licence Holders) who had undergone Boeing 737 simulator training at British Caledonia were to undergo training on aircraft, which broadly consisted of circuits and landing involving 3 take offs and 3 landings for each trainee. This training was being conducted so that pilot trainees could be prepared for the skill test (CA 40(A) Check) for the endorsement of rating in their licences as co-pilot on Boeing 737 aircraft. Capt. P.Khurana a DGCA approved instructor was to impart the training. This was the first assignment of Capt. P.Khurana as an Instructor. The flight plan was filed for carrying out local training flight which included circuits and landings for a period of two hours. Prior to training flight, the crew had undergone pre-flight medical check. The aircraft took-off at 14:12 hrs.IST and carried out 5 left hand circuits uneventfully from runway 28 which included touch and

go. After the 5th circuit, the aircraft carried out touch and go and after it was airborne for carrying out 6th circuit, aircraft was seen turning to left after reaching a height of about 400 feet. It continued turning left and crashed near bay 46 of Terminal II (International Terminal). The aircraft disintgrated and caught fire. The moving portions of the aircraft wreckage hit the Aeroflot IL-86 aircraft parked at bay 45. The number of disintegrated pieces of aircraft moved in two trails - one on the road adjoining the terminal building and another in the direction towards the Aeroflot aircraft upto bay 41. There was extensive fire and most of the disintegrated portions of the Sahara aircraft were subjected to fire. The Aeroflot aircraft also suffered impact damage and was engulfed in a big fire. The fire fighting facilities reached the site of the crash and later extinguished the fire. The Aeroflot aircraft fuselage was extensively burnt, however, the wings which contained more than 50 tonnes of fuel remained more or less intact. All the four crew members of Sahara India Airlines were killed. The 4 personnel of Aeroflot, who were working on the aircraft were exposed to severe fire and succumbed to injuries. One Bharat Petroleum contractor who was working nearby Aeroflot aircraft also succumbed to fire injuries. Three Oberoi Flight Services personnel, who were in their vehicle near the Aeroflot aircraft suf-

fered fire injuries. Also one IAAI contractor, who was working in the area, suffered fire injuries. The injured were taken to hospital and duly attended to. The accident occurred at 14:54 hrs. IST in the day-light conditions.

1.2 **INJURIES TO PERSONS**

a. **Fatal**

1.	Capt.P.Khurana	Sahara India Airlines	Indian	
2.	Sh.Vidul Mahajan	Sahara India Airlines	Indian	
3.	Sh.P.Singh	Sahara India Airlines	Indian	
4.	Ms.A.Khurana	Sahara India Airlines	Indian	
5.	Sh.B.P.Mashi	Bharat Petroleum	Indian	Died in Safdarjang Hospital.
6.	Sh.Ivonov	Aeroflot	Russian	
7.	Sh.Gorbachov	Aeroflot	Russian	
8.	Sh.Analdi Nikolai	Aeroflot	Russian	Died in Safdarjang Hospital.
9.	Sh.Damodran	Aeroflot	Russian	Died in Safdarjang Hospital.

b. **Injured**

1.	Sh. Gautam Chatterjee	Oberoi Flight Kitchen	Indian
2.	Sh.Ravinder	Oberoi Flight Kitchen	Indian
3.	Sh.Ikrar	Oberoi Flight Kitchen	Indian

1.3 DAMAGE TO AIRCRAFT

Sahara India Airlines aircraft disintegrated on impact into a number of pieces and subjected to extensive fire and was completely destroyed.

1.4 OTHER DAMAGE

Aeroflot aircraft was destroyed due to impact damage and fire. As the aircraft crashed in the Apron area, the ground equipments and number of aero-bridges were damaged. The details are as follows:

a. AEROFLOT IL-86 AIRCRAFT

Aeroflot IL-86 aircraft, registration No.RA 86119, was operating the flight under call sign AFL-558 on route Singapore-Delhi-Moscow. This aircraft had reached Delhi on 7.3.94 at 2310 hrs.IST. All the passengers (273) were off-loaded and were in the Terminal Building while the aircraft was prepared for the further flight. Later on when the flight was further delayed due to oil leakage in third engine, the passengers were accommodated in a hotel. The necessary repairs were carried out and the aircraft was refuelled (around 55 tonnes in the wings) at 1330 hrs. IST and was parked in bay no.45. The aircraft was to depart at

1830 hrs. IST. The engineers inside the aircraft were preparing the report when the accident took place. The baggage and hand baggage of transit passengers and the cargo were totally destroyed during the accident.

b. **AEROBRIDGES AND APRON AREA OF IAAI.**

Two Aerobridges 44 and 45 were damaged. Aerobridge no.45 was extensively damaged as a result of fire and debris strike. Approx.25,000 sq.mtr. of apron area opposite to bay no.41-46 was affected and approx. 5,000 sq.mtr. of the surface was badly damaged.

c. **GROUND EQUIPMENT**

Number of ground equipment of Air India and Indian Airlines and Oberoi Flight Services which were parked on the apron area suffered fire damages. Following are the details of damaged ground equipment:

OBEROI FLIGHT SERVICES

One Tempo traveller No.DDL 7031 - catering van.

AIR INDIA

i. Aircraft Tow Tractor

ii. Ground Power Unit

iii. Toilet Cart

iv. Water Cart

INDIAN AIRLINES

i. Ground Power Unit

ii. Bulk Freight Loader (BFL)

iii. Ambassador Car

iv. One Coach and GPU partly damaged.

1.5 PERSONNEL INFORMATION

1.5.1 Instructor

Name :Capt.P.Khurana

Date of Birth/Age :12.5.1951/43 years

Licences Held :

S.No.	Licence	No.	Date of Initial Issue	Currently Valid
1.	SPL	4098	15.7.69	-
2.	PPL	1658	23.6.70	-
3.	CPL	1041	11.3.74	-
4.	SCPL	558	23.11.82	-
5.	ALTP	1226	16.4.85	18.5.94
6.	COP/RTR	2744	18.1.72	17.1.95
7.	FRTO	1902	31.1.73	18.5.94

Ratings :Instrument Rating No.630 Issued on 6.11.79 on HS-748 aircraft & 26.3.83 on B-737.

Date of last IRC/LR/RC carried out: IRC(Instrument Rating Check) 5.6.93 LR

(Licence Renewal Check) 31.12.93.

RC (Route Check) 8.10.93.

Type of Aircraft Flown :DHC-1, Pushpak, HS-748 and B-737.

Date of Endorsement as Pilot-in-Command(PIC)/ Co-Pilot

:Aircraft	PIC	Co-pilot
:DHC-1	11.3.74	
Pushpak	15.3.75	
HS-748	3.7.84	6.11.79
B-737	29.6.88	21.4.83

Flying Experience

Total Flying Experience	:7263.20 Hrs.
Total Experience as PIC	:4540.20 Hrs.
Total Experience as PIC on Type	:2821.20 Hrs.
In last 30 Days	:108.10 Hrs.
In last 7 Days	:26.20 Hrs.

Date	: Total Hours
1.3.94	04.10 Hrs.
2.3.94	03.50 Hrs.
3.3.94	05.20 Hrs.
4.3.94	03.50 Hrs.
5.3.94	05.20 Hrs.
7.3.94	03.50 Hrs.
In last 24 Hrs.	03.50 Hrs.

CHECK PILOT / INSTRUCTOR APPROVALS.

a) Approved as Check Pilot on B-737 aircraft for Indian Airlines in 1992, vide DGCA letter No.8.1.92.L(1) dated 7.4.92. However, Capt.Khurana did not undergo Check Pilot's Assessment/Training and as such was never utilised as a Check Pilot on B-737 aircraft while in service with Indian Airlines.

b) Details of Capt.Khurana experience in M/s.East West Airlines was as follows:

Date of Joining	: July 1992
Date of Leaving	: May 1993
Total Flying Experience in East West	: 556.55 Hrs.(Approx.)

M/s.East West vide their letter dated 9.11.92 had requested DGCA for appointment Capt.P.Khurana as Check Pilot along with their other pilots. However, DGCA had not approved Capt.Khurana as Check Pilot probably keeping in view the number of Check Pilots to be approved in the organisation.

c) Details of Capt.Khurana's experience in M/s.Modiluft was as follows:

Date of Joining	: May 1993
Date of Leaving	: 2.11.1993
Total Flying Experience in Modiluft	: 166 Hrs.(Approx.)

Modiluft had requested to DGCA vide their letter dated 19.8.1993 for approval of Capt.P.Khurana as Instructor and it was certified that he is meeting various clauses/requirements of AIC 7 of 1990. DGCA, however,

approved Capt.p.Khurana as Check Pilot on B-737 for Modiluft vide DGCA letter No.8-47-93-L(II) dated 9.9.93.

Capt.P.Kling, Director Flight Crew Training, Lufthansa German Airlines in his Pilot's Proficiency Report (Transition Training) in respect of Capt.P.khurana made the following observations:

Capt.Khurana's knowledge and understanding of technical systems and procedures is excellent.

Phase 1 (acting as Pilot Flying)

His aircraft handling in all given situations (normal and abnormal) is good. Crew coordination and crew resource management is timely and adequate.

Phase 2 (acting as Pilot-not-Flying/Instructor).

Capt.Khurana's corrective action, just verbally or to the extent that he takes over control, is based on the principles of flight crew training. The safety of the training flight is at no times in jeopardy.

Due to his performance, I recommend that Capt.Khurana is trained as Instructor pilot.

According to Modiluft regulations, this training is as

follows:

a) Simulator student training under supervision,

b) Route check on right hand seat, and

c) Line student training under supervision.

Modiluft vide their letter dated 29.10.1993 had requested DGCA for approval of Capt.Khurana as Instructor on B-737 aircraft on the basis of following training which he underwent in India and at Lufthansa Flight crew training centre:

IN INDIA:

i) Flying training with Lufthansa Examiner at Nagpur on 23.9.1993 which included 7 touch and go with three overshoots covering abnormal simulated faults and circuits/landings.

ii) Route check during day from right hand side with Lufthansa Examiner on 8.10.1993.

iii) Route check by night from right hand side with Lufthansa Examiner on 25.9.1993.

IN FRANKFURT, GERMANY (AT LUFTHANSA FLIGHT CREW TRAINING CENTRE):

Capt.Khurana underwent the following training for Instructorship at Lufthansa from 18.10.1993 to 21.10.1993:

i) A total of three hours training of normal and abnormal procedures in right hand seat of their B-737-200 simulator (six axis).

ii) A subsequent cross-check in the simulator while occupying the right hand seat.

iii) A total of eight hours of instruction under supervision in the simulator.

However, Modiluft vide their letter dated 10.5.1994 had intimated that Capt.Khurana left their organisation without completing the training for acting as Check Pilot/Instructor. He was not cleared as route Check Pilot or instructor on Modiluft fleet since he did not complete line student training under supervision.

d) Details of Capt.khurana experience in M/s.Sahara India Airlines is as follows:

Date of Joining :3.11.1993

He was approved as Check Pilot on B-737 for Sahara India Airlines vide DGCA letter No.8-66/93-L(II) pt. dated 24.12.93. After his approval as Check Pilot and till the date of accident, he had done four route checks.

M/s.Sahara India Airlines had requested DGCA vide their letter dated 28.2.1994 for approval of Capt.Khurana as instructor. Capt.V.N.Arora, Chief Operations Manager, Sahara India Airlines certified that Capt.Khurana is meeting the requirements laid down in AIC 13 of 1993 and also certified that he had done 40 hours of LOFT training and six route checks at the time of submission of papers. Later he intimated that Capt.Khurana had carried out only four route checks as a Check Pilot. He also indicated the completion of following training of Capt.P.Khurana:

i) A total of three hours training of normal and abnormal procedures in right hand seat of their B-737-200 simulator (six axis).

ii) A subsequent cross-check in the simulator while occupying the right hand seat.

iii) A total of eight hours of instruction under supervision in the simulator.

iv) Flying training with DGCA Examiner at Nagpur-7 touch and go with three overshoots covering abnormal simulated faults and circuits/landings.

v) Route check (day) by right hand side with DGCA examiner.

vi) Route check (night) by right hand side with DGCA examiner.

Capt.Khurana was approved as Instructor on B-737-200 for Sahara India Airlines vide DGCA letter No.1.569/69-A(1) dated 8th March 1994.

Medical	:Undergone last medical at Air force CME, New Delhi on 8th Nov., 1993. He was declared medically fit for renewal of his Airlines Transport Pilot's Licence.
	Capt.Khurana was declared temporarily medically unfit for all flying licences for a period of 3 months w.e.f. 16.3.72 due to deflected Nasal septum (Left) inadequate airways. He was advised to consult ENT specialist for treatment of his nasal condition. He was subsequently declared fit on 14.4.72.
Accident/Accident	:Capt.Khurana was earlier involved in an incident on 16.2.1989 wherein while operating Indian Airlines flight IC-490 (Imphal-Guwahati),

he made an approach for landing at Barapani and subsequently overshot after reaching about 200 feet above the runway at Barapani. He was severely warned to be more careful in future and adhere to laid down procedures vide DGCA letter No.1-569/69/L(1) dated 5th April,1989. He had undergone refresher course and subjected to two route checks. His performance was also monitored for a period of one year.

1.5.2 **PILOT TRAINEES**

A. P/T PRAMOD SINGH

Date of Birth :1.3.1969

Licence Details :He was issued Commercial Pilot Licence vide Certificate No. 2408149 by Federal Aviation Administration-Department of Transportation-USA on 25.7.89.

Commercial Pilot Licence (CPL) No.2037 was initially issued by DGCA in 7.11.89. The Licence was valid upto 1.11.95.

Flight Radio Telephone Operator's Licence No.4025 valid upto 1.11.95.

Instrument Rating No.1424 valid upto 10.9.1994 (on Cessna 152 A).

Types of Aircraft Flown:Aircraft flown during training: PA 38 (Piper Tomahawk),PA 28 (Piper Cherokee), PA 28 R (Piper Arrow),BE 76 (Beechcraft Duchess) and Cessna 152 A.

Total Flying Experience	:330 Hrs.
Pilot-in-command	:229 Hrs.
Dual Hours	:86 Hrs.
Total Multi-engine Time	:16 Hrs.
Total Instrument Time	:65 Hrs.

In addition, he had supernumerary experience of 140 hours on

B-737 aircraft including 90 hours with East West Airlines and 50 hours with Sahara India Airlines.

Gliding Experience :137 winch to launches

Technical Qualification :Attended DGCA Approved Course from Delhi Flying Club and passed DGCA B-737-200 Technical & Performance Examination in Aug./Sept.,1993. He underwent Simulator Training at British Caledonia from 14.12.93 to 1.1.94 and completed 54 hours. (Pilot Flying + Pilot Not Flying). He had completed 3 circuits and landing practice on the aircraft during the training sortie on which crash took place.

Last Medical :Undergone last medical at Air Force CME on 10.1.94. He was found fit medically.

P/T ANSHU KHURANA

Date of Birth & Age :20.6.1971/23 years

Licence Details :She was issued Commercial Pilot Licence vide Certificate No.2450375 by Federal Aviation Administration - Department of Transportation-USA on 15.3.92.

:Commercial Pilot Licence (CPL)No.2429 was initially issued on 26.5.1992 by DGCA. The Licence was valid upto 15.4.1995.

:Flight Radio Telephone Operator's Licence No.4551 valid upto 15.4.1995.

:Instrument Rating No.1828 valid upto 10.9.1994 (on Cessna 152A).

Types of Aircraft Flown :Aircraft flown during training:

Cessna 152, Cessna 152A, Cessna 150, Cessna 172, Cessna 310A, Cessna 310 I, Pushpak, Grumman AA5.

Total Flying Experience :280 Hrs.
Pilot-in-Command :172 Hrs.

In addition, she had supernumerary experience of 50 hours on B-737 aircraft with Sahara India Airlines.

Technical Qualification :Attended DGCA Approved Course from Delhi Flying Club and passed DGCA B-737-200 Technical and Performance Examination in Jan.1994. She underwent Simulator Training at British Caledonia in Feb, 1994 (5.2.1994 to 22.2.1994) and completed 52 hours (Pilot Flying + Pilot Not Flying).

:She was authorised by DGCA to undergo training with Capt. P. Khurana vide DGCA letter No.1-476/92-L (1) on 8.3.1994.

:She was on the aircraft for carrying out circuits and landings when the crash took place.

Last Medical :Undergone last medical at Air Force CME on 22.12.93. She was found fit medically.

C. **P/T VIDUL MAHAJAN.**

Date of Birth & Age :25.1.1967/27 Years

Licence Details :He was issued Commercial Pilot Licence vide Certificate No. 2460345 by Federal Aviation Administration - Department of Transportation-USA on 13.11.1991. Commercial Pilot Licence (CPL) No.2418 was initially issued in 12.5.1992 by DGCA. The Licence was valid upto 15.4.1995.

Flight Radio Telephone Operator's Licence No.4535 valid upto 15.4.1995.

Instrument Rating No.1823 valid upto 10.9.1994 (on Cessna 152A).

Types of Aircraft Flown	:Aircraft flown during training:
	:Cessna 150, Cessna 152, Cessna 152A, Cessna 172, Cessna 310, Grumman AA5, Beechcraft A-23, Citabria 7ECA.
Total Flying Experience	:330 Hrs.
Pilot-in-Command	:244 Hrs.

In addition, he had supernumerary experience of 150 hours on B-737 aircraft with Sahara India Airlines.

Technical Qualification	:Attended DGCA Approved Course from Delhi Flying Club and passed DGCA B-737-200 Technical & Performance Examination in Dec.1993. He underwent Simulator Training at British Caledonia in Feb, 1994 (5.2.1994 to 22.2.1994) and completed 52 hours (Pilot Flying + Pilot Not Flying).
	:He was authorised by DGCA to undergo training with Capt.P. Khurana vide DGCA letter No.1-476/92-L(1) on 8.3.1994.
	:He was on the aircraft for carrying out circuits and landings when the crash took place.
Last Medical	:Undergone last medical at Air Force CME on 10.12.93. He was found fit medically. He was advised to wear corrective bifocal/look over glasses.

Delhi Flying Club has given the following phases of training which the Pilots undergo for type endorsement:

Phase-I: This phase of endorsement training involves ground training covering systems and aircraft

performance. Faculty of Flight Safety Services Delhi Flying Club is approved by the DGCA to conduct this training as per a prescribed syllabus. After successful completion of the course, trainees are put up for the exam. conducted by the CEO, DGCA.

Phase-II: On attaining 'PASS' STATUS IN THE CEO, DGCA exam, the trainee pilot is eligible to go through phase 2 of the endorsement process. During this phase he has to carry out simulator training as approved by the DGCA. The Faculty of Flight Safety Services had approached the DGCA and got the following approved for the benefit of trainee pilots who successfully complete their ground traiing at this faculty:

1. The 737-200 simulator of British caledonian Flight training.

2. Capt.R.N.Rao as Simulator Instructor (B737-200).

3. Capt.V.K.Sharma as Examiner (B737-200).

On successful completion of simulator training and there after passing a simulator check by the DGCA approved examiner, the students pass on to phase 3. Simulator training/checks are recorded in triplicate in a bound booklet 'Simulator training Report' for each trainee pilot. At the end of a simulator training this

booklet is handed over to the trainee for presenting it to the agency conducting his flying training and checks.

Phase-III: Trainee Pilots who successfully complete phase I & II as stated above, join an Airlines, who then conducts their flying training. On completion of flying training and checks, one copy of the 'Simulator training report' and the flying training report are submitted to the DGCA for obtaining type endorsement.

As reported by Sahara India Airlines, the records of the trainees were with them on board the aircraft and have been destroyed during the crash.

GENERAL COMMENTS BY CAPT.R.N.RAO ABOUT PERFORMANCE OF TRAINEES AS PER HIS PERSONAL DIARY DURING SIMULATOR TRAINING:

TRAINEE PILOT P.SINGH

14.12.93 - 0200 Hours

Performance standard as per his existing experience.

15.12.93 - 0200 Hours

Carried out briefing and simulated C.P.T. in the room for four hours.

Needs practice to handle and scanning.

16.12.93 - Off - Gave them lots of home works for three days.

17.12.93 - Off

18.12.93 - Off

19.12.93 - Off

20.12.93 - 0200 Hours

Showed slight improvement in the performance. Still needs lots of hard work.

21.12.93 - 0200 Hours.

Briefing and simulated CPT done for approx.four hours. Improved both on handling and scanning. However, must work hard for anticipation while on let down.

22.12.93 -

Briefing in the room on single engine. Simulated CPT for approx. four hours.

Needs more practice for Rudder and Stab Trim.

After this Trainee Pilot P.Singh was flying with Pilot Trainee Tripathi as PNF

(Pilot not flying).

On 27.12.93 cleared for CA40(A) check on simulator.

28.12.93 - Off

Lots of briefing on all types of circuits and landings

and simulated CPT carried out at Guest House.

29.12.93 -

Both the pilots successfully completed CA40(A) checks with Capt.V.K.Sharma.

30.12.93 - 0200 Hours

Circuits and landings two engine normal and bad weather circuits and over shoot. Standard.

1.1.94 - 0200 Hours

Circuits and landings

All types of circuits and landings, over shoot, let down carried out satisfactory.

<u>Trainee Pilot V.Mahajan & Miss A.Khurana</u>

4.2.94 -

Miss.A.Khurana requested on phone to postpone the training for next day as they were feeling very tired. Accepted their request and accordingly informed Mr.Martin at British Caledonia.

5.2.94 -

T/P V.Mahajan 0400 Hours

T/P Miss A.Khurana 0400 Hours

Performance standard as per their existing experience. General Flying, Air works and stall series carried on.

6.2.94 - 0400 Hours

Briefing and simulated CPT carried out at the Guest House for approx. 4 hours. Both require lots of hard

works to do the training. Handling, scanning is quite poor. General Flying, Air works, stall series and constant rate of descent. Must work hard and concentrate on scanning all the instruments.

7.2.94 - 0400 Hours

Must concentrate on handling, scanning, Power relations with IVSI.

Briefed let down at Guest House and carried on simulated CPT for 4 hours.

Miss Khurana must work hard to remember the procedure.

8.2.94 - Off

Lots of briefing and simulated CPT at Guest House. Seems to have picked up the procedure nicely. On CPT actual simulator Mahajan performance was reasonably OK. However, Miss Khurana requires prompting while doing the let downs though she understood the procedures.

9.2.94 - 0400 Hours

Improved on handling. Needs to improve scanning still: Heading, Height and speed within limits. Procedure on let down requires prompting though they have understood.

10.2.94 - 0400 Hours

Lots of home works, briefing particularly on single engine and simulated CPT carried on at Guest House.

Introduced and demonstrated single engine. Needs

practice to keep a/c straight and altitude. Must improve Rudder trimming accurately. Needs more practice for trimming.

11.2.94 - 0400 Hours

Performance on both engines flying is standard. Scanning and handling improved. Heading, Heights and speeds within limits, (Miss Khurana must work hard to improve still) On single engine hesitates Rudder Trimming. Forgets stab Trim on single engine, gets panicky on single engine, as such scanning goes out. Needs more practice.

12.2.94 - Off

Kept them busy whole day by giving them home work. In the evening briefing, simulated CPT carried on. Single engine VOR/ILS let down carried on simulated CPT at Guest House. Seems to have picked up the procedure.

13.2.94 - 0400 Hours

Improved on scanning on single engine. Rudder and Stabilizer trimming improved, showed hands off flying (Miss Khurana at times forgets to trim whenever change of power is there, on prompting remembers) Single engines VOR/ILS let down within limits.

14.2.94 - Off

Kept busy with briefing and simulated CPT practically whole day.

15.2.94 - 0325 Hours

Performance standard. Simulator motion u/s, could not complete the training as per schedule (Miss Khurana).

16.2.94 - V.Mahajan -0200 Hours

Standard. Miss Khurana could not do as the motion was u/s.

17.2.94 - Off

18.2.94 -0235 Hours

Training completed. performance attain standard. Cleared for CA40(A) Checks on Simulator.

19.2.94 -

Both completed CA40(A) checks successfully with Capt.V.K.Sharma.

briefing done on all types of circuits and landings, different power settings. Procedures for circuits and landings explained. Simulated CPT carried on at Guest House.

20.2.94 -0400 Hours

Both engines normal/bad weather circuits and landings and over shoot carried on.

At times forgets the appropriate check list otherwise performance OK.

-Briefing and CPT at Guest House carried on.

21.2.94 -0400 Hours

Single engine normal/bad weather circuits and landings carried out. Performance standard.

22.2.94 - 0400 Hours

All types of circuits and landings carried out satisfactorily. Finish the training Standard.

CERTIFICATE ISSUED IN RESPECT OF TRAINEES BY CAPT.V.K.SHARMA, DGCA APPROVED BOEING 737-200 EXAMINER TO FLIGHT SAFETY SERVICES OF DELHI FLYING CLUB ON 19.2.1994

This is for your information and record that after completion of the required simulator exercises successfully under Capt.R.N.Rao (DGCA approved B 737-200 Simulator Instructor), the following Trainee Pilots who had undergone ground training at the Faculty of Flight Safety Services, have been given a Simulator Check ride by me today. Their proficiency has been assessed as 'Standard' and they are found fit to undergo CA 40 A on B 737-200 aircraft.

1. Trainee Pilot VIDUL MAHAJAN.

A similar certificate was issued by Capt.V.K.Sharma in respect of trainee pilot Pramod Singh on 29.12.1993.

1.6. AIRCRAFT INFORMATION

Boeing 737-200 model 2R4C (Combi) bearing aircraft Sl.no. 21763 was manufactured by Boeing Company in Dec. '79. This aircraft was purchased by M/s.Air Executive Norway Busy Bee A/S and was operating under the Registration No.LN-NPB. The aircraft was maintained by M/s.Braathens SAFE, Norway upto May, '91. After that it was purchased by Leasing Company of United States M/s. GAC, USA II(Inc) New York. It was given the American Registration No. N401MG on 8.6.92. In USA the aircraft was maintained by M/s.PEMCO Aeroplex, Dothan ALABAMA.

Before delivery to Sahara India Airlines, the aircraft had undergone major checks 7c, Corrosion Prevention & Control Programme (CPCP) and structural inspection. The aircraft was taken by Sahara India Airlines under lease agreement in Nov., '93 between GAC USA II as Lessor and Sahara India Airlines Ltd. as Lessee. The Export Certificate of Airworthiness (NO.E 286227) was issued by FAA of USA for this aircraft on 18.11.93. The aircraft was deregistered from American Register on

3.12.93 and it was registered in India on 6.12.93. The Certificate of Registration No. 2450 with registration marking of VT - SIA was issued to M/s.Sahara India Airlines. When the aircraft landed in India, it had logged total time/total cycles as 25352 hrs./21555 cycles. The aircraft was equipped with two Pratt and Whitney JT8D-17 engines bearing Sl.No. 702652 and 688188. When the aircraft landed in India, Engine Sl.No.702652 had done 23127 hrs./19731 cycles since new and 12587 hrs/10974 cycles since overhaul and the engine Sl.No. 688188 had done 23983 hrs./10395 cycles since new and 2570 hrs./1239 cycle since overhaul.

The aircraft was issued with Indian Certificate of Airworthiness on 9.12.93 initially for a period of three months. Subsequently, it was revalidated for a period of three months upto 7.6.94 on 7.3.94. The Flight release Certificate which was issued on 6.3.94 was valid upto 5.5.94/26283 aircraft flying hrs. The aircraft category is normal with passenger/mail/goods aircraft. The minimum crew necessary is two and maximum weight authorised at Brake release is 53750 kgs. This aircraft is 123 passenger configuration. Flight Release Inspection Schedule (350 flying hrs/60 days) was carried out on this aircraft on 6.3.94 for the purpose of Certificate of Airworthiness revalidation. As on date of accident, following was the aircraft

status:

Aircraft hrs.since new	25947
Cycles since new	21861

After arrival of the aircraft in India, the aircraft had undergone 1st check 'C' (350 hrs./60 days/flight release inspection) on 30.1.94. After renewal of C of A on 7.03.94, the aircraft had flown 5-05 hrs./2 cycles Delhi-Bangalore-Delhi flight on 8.3.94 and was released for training flight when it met with the accident.

Check 'B' and pre-flight inspection on the aircraft was carried out by Sh.A.K.Chonna, AME, on 8.3.94.

With the previous operators before arrival in India, the aircraft was involved in three incidents, the details of which are as follows:

1. Aircraft was hit by lightening strike at Basel Switzerland. The graphite rudders trailing edge was splitted over a length of 0.5 mtr. Necessary permanent repairs were carried out.

2. Skin scratches/dents aft of external power door. On skin between frames 235.8/251.6 and Stringers 2IR/23R external repairs were carried out.

3. Aircraft hit runway with tail on take off at

Bardufoss. Fuselage skin between BS 967 and 1040, frame and bulk head BS1016 damaged.

During the operation with Sahara India Airlines, on 17.02.94 the aircraft was involved in taxing incident at Bangalore when the aircraft port wing hit a coach while going to the parking bay. The aircraft slat No.2 was damaged.

No mandatory Modifications/Inspection were outstanding at the time of accident.

Life limited components of the aircraft and engines were within the prescribed/approved limit.

SUMMARY OF AIRCRAFT DETAILS

Aircraft Type/Model	B-737-200
Aircraft Registration No.	VT-SIA
Aircraft SL.No.	21763
Manufacturing Date	12.12.1979
Time Since New	25947 hrs.
Cycles	2861

Time Since Ist C of A as on 7.3.94- 591 hrs

Time Since Last C of A as on 8.3.94- 5 hrs.

SUMMARY OF ENGINE DETAILS

i. Port Engine

Sl.No.	688188
Date of Manufacture	Jan.,'80

Time/Cycles since new 24578 hrs./10701 cycles.

Hrs./cycles since last 3165 hrs./1545 cycles.
Overhaul.

ii. Starboard Engine

Sl.No. 702652

Date of Manufacture Dec.,'79

Hrs./cycles since new- 23722 hrs./20037 cycles

Hrs./cycles since last- 13182 hrs./11280 cycles
Overhaul

DETAILS OF REPORTED DEFECTS

There were no repetitive defects from the date of issuing of Ist C of A till the date of accident except that of defect on right airconditioning pack which occurred on 5.01.94 and repeated on 7.01.94.

Further, during the scrutiny of records, following defect of engines and aircraft occurring during the preceding seven days were observed.

Date/Sector	Reported Snag
From 1.3.94 to 3.4.94	Nil
2. 4.3.94/Madras-Delhi	1.PDCS is U/S. 2.P1 side overhead speaker gives lot of whistling noise when on No.1 ASP Toggle switch is selected to "INT" position. 3.During climb throttle stagger is observed No.2 thrust

lever is ahead of 1/2".

Parameter observed as:

ENG.	EPR	N1	EGT	N2	Fuel Flow
No.1	2.01	82%	515oC	83%	2700
No.2	2.01	82%	530oC	83%	2600

4.Taxi light U/S.

3. 5.3.94/BLR-DLH — Capt.side frequency selector (VHF)U/S.

4. 6.3.94 — Check 'C' (FRC Check carried out by the operator)

5. 7.3.94 To 8.3.94 — Nil.

During the training flight, pilot did not make any report of emergency on board.

AIRCRAFT WEIGHT SCHEDULE

Empty weight	29535 kgs. (Index 17.92 and MAC% 30.6%)
Variable load	118.8 kgs.portable water and 20 kgs.ship library
Weight of Fuel (Full tanks)	16596 kgs.
Operating empty weight	30184 kgs. (Index 16.36)
Maximum Zero fuel weight	43091 kgs.
Maximum permissible landing weight	46720 kgs.
Maximum authorised weight at Brake release	53750 kgs.
Maximum sitting capacity	131 which includes two pilots, two observers and four cabin

crew.

LOAD AND TRIM SHEET DETAILS DURING THE TRAINING FLIGHT

For the training flight aircraft was loaded 15 tonnes of fuel and there were four crew members which included one instructor and three pilot trainees. At take off aircraft weight was 46720 kgs. Ballast weight of 1959 kgs. was placed in the cargo holds with 1359 kgs. in the forward cargo hold and 600 kgs. in the aft hold. At the take off centre of gravity was at 17.02% MAC which indicated trim setting of 5 3/4, 6 1/4.

Taking an average fuel consumption of 3 tonnes per hour, it is estimated that for the flight time of 45 minutes prior to crash, the fuel consumed would be around 2300 kgs. and the remaining fuel would be around (14800 - 2300) 12500 kgs. The estimated CG position comes to around 18.4% MAC which will give trim setting as 5 1/2, 6. The CG position and the aircraft weight are within the envelope. The fuel used onthe aircraft is Aviation Turbine Fuel.

1.8 AIDS TO NAVIGATION

The aircraft was flying local VFR circuits.

The runway in use was 28. The aircraft had carried out five 'touch and go' before the accident. Nothing was reported against the functioning of the Nav Aids at Delhi airport.

1.9 COMMUNICATIONS

The aircraft was fitted with Very High Frequency (VHF) and High Frequency (HF) communication equipments. The aircraft was in two way communication with Tower. It is evident from the Air Traffic Control (ATC) tape transcript that the aircraft had no problem on communication during all the circuits. Prior to sixth circuit the aircraft was advised that the runway in use would be 27 so climb on runway heading to 3500 ft. and further climb with Delhi Radar. The aircraft acknowledged the last transmission by Tower. The initial take-off was executed at 0842 UTC (1412 IST) and the last 'touch and go' was carried out on 0923 UTC (1453 IST).

FOLLOWING CHANNELS OF COMMUNICATIONS ARE AVAILABLE AT PALAM AIRPORT:

Service	Call Sign	Frequency
Surface Movement Control	Delhi Ground	121.9 MHZ
Aerodrome Tower Control	Delhi Tower	118.1 MHz
Approach Control	Delhi Approach	127.9 MHz
Area Control Centre(East)	Delhi Control	120.9 MHz
Area Control Centre(West)	Delhi Control	124.55 MHz
Area Control Centre(Standby)	Delhi Control	124.2 MHz
Aerodrome Surveillance Radar	Delhi Radar	119.3 MHz
Air Route Surveillance Radar	Delhi Radar	120.9 MHz

No unserviceability on these channels were reported. ATC tape transcript of the Surface Movement Control (121.9 MHz) and Tower Control (118.1 Mhz) and ATC unit telephones are enclosed at Annexures 'B', 'C' & 'D'.

1.10 AERODROME INFORMATION

IGI Airport is about 15 Kms away from Delhi. The administrative authority of the airport is vested with International Airport Authority of India, New Delhi and Air Navigation Services is provided by National Airport Authority. The aerodrome is operational for full 24 hours.

The elevation of IGI Airport is 227 metres AMSL.

The geographical coordinates of the airport reference point are :283407 N; 770648 E.

There are two take-off and landing runways: runway 28/10 and 27/09. Runway 28 (true bearing 284 degrees) is the main Instrument Runway. The elevation of threshold runway 28 is 776 ft. (239 metres) AMSL. The declared distances of runway 28 are as follows:

Landing Distance Available (LDA)	:3810 metres
Take-off Distance Available (TODA)	3810 metres
Width of Runway	46 metres
Length of Clearway	274 metres
Type of Surface	Asphalt
PCN	55

There are two aprons - domestic and international.

INTERNATIONAL APRON (APRON-II):

International Apron is accessible by taxiways L,M,N,P,Q,R. The international aircraft after landing on runway 28 clear the runway on any one of the high speed taxiways i.e. L,M, or at the end of runway on taxi track N to proceed to the international parking area normally known as Apron II, which is on the southern side of runway 28/10.

There is the provision of parking a maximum of 18 aircraft on Apron II. These parking stands are numbered serially. The parking stand No.41 to 49 have the provision of Aero-bridge. These stands are also provided with the Visual Docking System. In addition there is a remote apron having Bay Nos.81 to 85. Aerobridge facility is not available in remote apron.

Cargo aircraft are parked in Cargo Apron which is accessible by taxiway 'Q'. There are four parking stands in this apron. They are numbered from 99 to 102.

DOMESTIC APRON (APRON-I):

The domestic terminal of IGI Airport is on the northern side. The taxiways leading to this terminal are A,B,C,D,E. The domestic and Indian Air Force aircraft, after landing on runway 28 normally clear the runway on taxiway D and Taxi on runway 27 for coming to domestic parking bays or proceed to Air Force Technical area on the northern side of runway 27.

CONTROL TOWER:

The ATC Control Tower building which is at a height of 39.34 metres above ground level, contains other offices of Air Traffic Control and Aeronautical Communication Stations like Area Control Centre, Air Route Surveillance Radar, Approach

Control Office, Terminal Area Radar, Equipment Room, H.F. R/T etc. A clear and unobstructed view of the whole airport including the Approach Area of runway 28/10 and 09/27, can be had from the ATC Control Tower in clear visibility.

FIRE STATIONS:

Delhi Airport is equipped with Cat IX fire fighting services. There is one Main Fire Station and two Sub Fire Stations.

Main Fire Station

Fire Tenders : Two

Ambulance : Two

Sub Fire Station I:

Sub Fire Station I is located at the domestic apron.

Crash Fire Tenders : Two

Sub Fire Station II: Two Crash Fire Tenders

Sub Fire Station II is located very close to Apron II. The Apron Control Tower II is located just above the Sub Fire Station II wherefrom an unobstructed view of Apron II and adjoining taxi tracks can be obtained.

Fire Tenders : Two

Ambulance : One

METEROLOGICAL INFORMATION:

An Automatic Terminal Information Service (ATIS) broadcast

is recorded by the Tower Controller after the receipt of each METAR or SPECI and it is broadcasted continuously on 126.4 MHz.

1.11 FLIGHT RECORDERS

Aircraft was fitted with Cockpit Voice Recorder and Universal Flight Data Recorder.

1.11.1 COCKPIT VOICE RECORDER (CVR)

Fairchild Cockpit Voice Recorder (CVR), Model No.A-100 bearing Serial no.3298 was fitted on aircraft. This recorder has magnetic tape recording on four channels. The channel recording is done for pilot, co-pilot, observer and area mike. Channel 1 is for Observer, Channel 2 is for First Officer, Channel 3 for Captain and Channel 4 is for Area Mike. The recorded information for last 30 minutes is retained.

The CVR unit had suffered impact and fire damage. The unit was opened at CVR Laboratory of DGCA. CVR outer cover was damaged and was cut to open the CVR. Inner metallic casing and tape assembly were found intact. The tape remained protected in the armoured unit. Condition of the tape was also found to be satisfactory. The tape was taken out and it was replayed at DGCA laboratory. The recordings were found to be proper. Initially reference time was given

during the preparation of tape transcript and then with the help of ATC transcript, reference timing was converted into Universal Coordinated Time (UTC).

1.11.2 UNIVERSAL FLIGHT DATA RECORDER (UFDR)

The aircraft VT-SIA was fitted with Sundstrand UFDR, Model No.980-4100-GX-US, Serial No.6543. The data is stored for last 25 hours of flight. The UFDR records 11 parameters. The parameters recorded in the UFDR are as follows:

1. Altitude.
2. Airspeed
3. Magnetic Heading
4. Roll Attitude
5. Pitch Attitude
6. Control Column Position
7. Vertical Acceleration
8. Longitudinal Acceleration
9. Engine Pressure Ratio (1 & 2 engine)
10. Elapsed Time
11. VHF Keying

The unit was externally damaged. The front panel along with the ULB and front socket had ripped open. The unit was exposed to fire and smoke could be seen on the side walls and also inside. The steel body containing the tape transport mechanism appeared to be

intact.

The unit was taken to Air India facilities at Bombay for opening and copying the data from the tape. Following observations were made:

The frame structure for mounting the electronic boards and the transport/environmental enclosure was bent on front side due to impact. The transport/environmental enclosure had detached from the mountings but appeared to be intact except for smoke deposit on casing. The top frame cover was removed by opening out the attachment phillips screws to take out the enclosure. There was no apparent damage to stepper motor, connector and the wiring appeared to be intact. The motor cover had detached during the impact and there was some stiction in the motor rotation, although the belt appeared to be intact. The condition inside the enclosure was good and tape appeared to be intact.

The enclosure of UFDR of the crashed aircraft was then installed in a serviceable UFDR of M/s.Sahara India Airlines. As the stepper motor of the crashed aircraft UFDR was jammed, the stepper motor of the serviceable unit was installed on the transport/environmental enclosure.

The data was then extracted at M/s.VSM Aerospace facil-

ties of Bangalore, who are an approved organisation working on this model of UFDR. The data however, did not come out completely.

RETRIEVAL OF DATA AT NATIONAL AEROSPACE LABORATORY

The unit was taken to the NAL facilities at Bangalore for recovery of data as at M/s.VSM facilities full data could not be recovered. At NAL, data of one more second just prior to crash was recovered. It was observed that most of data recovered needed refining. Engine's power parameter recordings (EPR values) were found normal.

After the necessary CVR tape speed corrections, co-relation of CVR and UFDR data (Engine Power Parameter) for the last about 4 minutes before the crash was prepared and is given below:

CORRELATION OF COCKPIT VOICE RECORDER TRANSCRIPT AND UNIVERSAL FLIGHT DATA RECORDER DATA (EPR VALUES ONLY)

TIME	EPR1	EPR2	TEXT
09:19:29	1.08	1.02	Maintain 2500.
09:19:37	1.08	1.02	Speed 172 knots.
09:19:39	1.14	1.04	Yah. Turn on heading 320 radar vector for you.
09:19:44	1.15	1.06	Turning Sir.
09:19:45	1.15	1.06	OK now localiser alive.Continue
09:19:47	1.15	1.06	Ha ha.
09:19:48	1.15	1.05	Late ho gaya.
09:19:52	1.15	1.06	Continue.
09:19:54			(ATC transmission with VRF).
09:20:04	1.22	1.10	Come on a heading of 260.
09:20:09	1.22	1.16	(Altitude alert horn).
09:20:11	1.30	1.27	Vidhul why are you descending.
09:20:15	1.38	1.33	OK heading is coming up.
09:20:19	1.38	1.33	260 is good.
09:20:24	1.39	1.34	You want to establish on 2000, it is OK.
09:20:27	1.41	1.35	It is OK chalo. You are back on the localiser now.
09:20:30	1.41	1.36	Back to the localiser.
09:20:39	1.41	1.36	Glideslope alive.
09:20:42	1.41	1.36	Landing gear down.
09:20:43	1.41	1.36	Gear down.

09:20:44	1.41	1.36	Flap
09:20:44			Fifteen.
09:20:45	1.41	1.36	Check list.
09:20:46	1.41	1.36	(Outer marker crossing sound starts). —
09:20:49	1.41	1.36	Localiser pakar lein pehle.
09:20:52	1.37	1.31	Pick up your localiser.
09:20:54	1.37	1.31	OK start switches.
09:20:56	1.37	1.31	Recall
09:20:58	1.37	1.32	Altimeter.
09:21:00	1.38	1.31	1014.
09:21:01	1.38	1.31	Speed brakes.
09:21:02	1.38	1.31	Victor India Alpha Delhi Tower.
09:21:05	1.37	1.31	Go ahead.
09:21:06	1.37	1.31	Roger after this touch and go runway in use will be 27. After touch and go on runway heading climb 3500 feet further climb with Delhi radar.
09:21:15	1.37	1.31	Copied Sir. After take off 2500, runway heading and will call you down wind for 27 Victor India Alpha.
09:21:20	1.37	1.31	Runway heading 3500
09:21:22	1.37	1.31	Copied 3500 and we call you down wind for 270.
09:21:26	1.37	1.31	Han ji.
09:21:28	1.37	1.31	Flap 25.
09:21:34	1.14	1.13	---Flap two five Sir. Altitude ---. (ATC transmission with other aircraft).

09:21:35	1.14	1.12	Getting too high isn't it.
09:21:37	1.09	1.05	So you do something.
09:21:40	1.08	1.02	What do we do.
09:21:41	1.08	1.01	Undercarriage down.
09:21:42	1.07	1.01	You have to take flap otherwise.
09:21:43	1.05	1.01	Sir flap 25.
09:21:44	1.04	1.02	OK.
09:21:47	1.03	1.02	Still we are very high.
			Flaps 30-40 Sir.
09:21:58	1.04	1.02	Thirty forty aaye ga he nahi mere pas 170 knots pe.
09:22:00	1.03	1.02	But any way get the speed first.
09:22:07	1.01	1.02	OK glideslope. Picking up the glideslope. It is going up.
09:22:11			(ATC transmission with VRF).
09:22:16	1.01	1.01	Add power now onwards otherwise You will be low.
09:22:22	1.27	1.23	Speed it up.
09:22:23	1.27	1.25	Trim trim trim trim nose down.
09:22:26	1.27	1.25	Nose down?
09:22:27	1.28	1.25	Ya because the pressure is coming in no.
09:22:28	1.28	1.25	_____.
09:22:29	1.28	1.25	Speed speed. Look at your speed.
09:22:36	1.37	1.32	We are on visual now.
09:22:37	1.36	1.32	Visual to hai speed bhi to laao.
09:22:42	1.41	1.37	Going below bug na.

09:22:44	1.42	1.37	Ya ya I am going down down down nothing happens.
09:22:48			_____.
09:22:49	1.30	1.28	Han just stuck to it.
09:22:50	1.30	1.28	Nothing happens to Boeings.
09:22:51	1.29	1.28	Just stuck to it yaar.
09:22:53	1.10	1.08	Ya.
09:22:54	1.06	1.03	Nothing happens.
09:22:55	1.04	1.01	(Touchdown sound).
09:22:58	1.03	1.02	Ke gal hai yaar. Chal straight. Runway seeda lagana.
09:23:07	1.99	1.88	_____rotate.
09:23:09	2.06	2.04	Rotate.
09:23:10	2.06	2.04	
09:23:11	2.07	2.06	
09:23:12	2.02	2.07	Nothing is happening.
09:23:14	1.86	2.08	Let's see what to do now.
09:23:16	1.69	2.09	Positive climb.
09:23:18	1.55	2.10	Gear up.
09:23:25	1.15	2.11	
09:23:26	1.10	2.11	(Horn sound).
09:23:27	1.08	2.11	
09:23:28	1.05	2.11	Rudder rudder rudder.
09:23:29	1.04	2.11	Na na leave leave.
09:23:30	1.04	2.11	Leave leave. Leave leave leave leave.
09:23:31	1.03	2.11	Ya aa...

09:23:32	1.03	2.12	
09:23:33	1.03	2.11	Stick shaker sound (continues till crash)
09:23:34	1.03	2.10	
09:23:35	1.05	2.08	
09:23:36	1.14	2.08	
09:23:37	1.13		Aah. (Crash Sound).

1.12. WRECKAGE AND IMPACT INFORMATION

The aircraft first impacted the ground at International terminal apron near Bay No.46 at a distance of approx 1700 feet from the runway centre line on its left side. The crash location is at a distance of about 10,800 feet from the beginning of runway 28. The aircraft disintegrated at the impact point and caught fire. The ground marks indicate that the aircraft path was at a heading of about 160 degrees from North. Photographs showing the wreckage at the crash site are at Annexure 'A'. Wreckage diagram and flight path diagram is enclosed at Annexure 'F' and 'G'. Wreckage examination of the aircraft revealed the following.

1.12.1 GROUND MARKS

At the initial impact point, aluminium metal rub marks could be observed at a heading of about 160 degrees from North. Fuel spillage and fire marks on the apron could be seen immediately after the impact point. After initial rub of about 70 feet, the ground marks could be seen branching of in two directions with one towards the Aeroflot aircraft and other towards the road adjoining the terminal building serving the various bays. The wreckage pieces moved on these two trails. Ground marks on the road could be seen upto the Bay No.41 where right engine was found. The Aeroflot aircraft parked at Bay No.45 was at a distance of about 450 feet from the initial impact point. The wreckage impact marks could also be seen on the Aerobridge

45 arm under which road for serving the bays passes. At number of places deep digging marks could be observed.

1.12.2 BREAK-UP PATTERN

From the scatter of wreckage, it could be seen that the port wing, cockpit and the fuselage, leaving the tail portion, and the portion of starboard wing got fragmented heavily indicating a very severe impact of the aircraft with the ground in left bank condition. The fire had started immediately at the impact. The aircraft wreckage moved in two trails one towards Aeroflot aircraft parked on Bay No.45 and the other towards road adjoining the terminal building serving various bays. The wreckage of left wing, cockpit and the front fuselage alongwith left engine moved towards the Aeroflot aircraft and impacted it. As a result of which, the Aeroflot aircraft suffered damage and caught fire. The wreckage was scattered over the appron area in front of Bay No.46 to 41. Most of the wreckage pieces suffered fire damage. Port engine which had passed across the Aeroflot aircraft suffered severe impact forces and was lying near the Aeroflot aircraft close to Aerobridge 45 pillar and was exposed to extensive fire. Cockpit portions in small pieces were found close to Aeroflot aircraft. Some of the wreckage got mixed up with the Aeroflot wreckage. The tail portion and the right engine were found on the road adjoining the terminal building serving the various bays.

However the starboard wing portion was found thrown away near Bay 41 on the apron and had suffered extensive fire damage.

1.12.3 **OBSERVATIONS FROM THE WRECKAGE**

a) Fire had erupted immediately at the impact point and fire marks could be seen on most of the wreckage pieces. Examination of the wreckage has revealed that the extent of fire damage is more prominent on the starboard side compared to port side. Further the fire damage is extensive in front portion of the aircraft.

b) The Aeroflot was hit by the wreckage as a result of which it was damaged and caught fire.

c) The cockpit of the aircraft was completely shattered and broken into small pieces. No observation of any use could be made.

d) Number of buckles on the fuselage portion identified to the portion on left side near cargo door indicated an impact angle of the fuselage with the ground of approx. 34 degrees pitch down.

e) Fuselage portion upto Station No. 867 was found ripped open. Forward portion had severe fire damage,whereas the rear portion had soot deposit. Interior of the

cabin was completely destroyed due to fire and impact. Only fuselage skin covering alongwith deformed structural members with grazing marks at few places could be recovered

f) Fuselage rear portion from 867 to 12317, with aft service door, was found in shape though damaged along with empennage. Port stabilizer along with corresponding elevator was destroyed and broke away from the main fuselage structure. Tip portion of starboard stabilizer broke away. Vertical fin was damaged at leading edge on tip due to crushing. Rudder portion from approximately its centre to bottom end ripped open and damaged due to fire. The aft air stair assembly was found largely intact. Main deck and cargo doors were located in this portion.

g) A large piece of the right wing, from about the normal location of No.2(right) engine to the aileron and outboard flat, was in shape but severely burnt. Leading edge slats and a portion of the training edge flaps were present, but severely damaged by fire. The left wing was found in many pieces with the largest portion found being a piece of upper wing skin about 2/3 the length of the left wing. Thi piece showed no evidence of fire. The wing centre section was also completely destroyed. However, a large number of centre wing pieces were identified, some with and without fire damage. A number of other pieces of wing and leading edge structure were found but their exact location on the

wing could not be easily determined. Other components such as spoilers, portions of ailerons and wing tank components, such as fuel boost pump, hydraulic system heat exchanger and tubing, were also found heavily damaged by impact and usually also by fire.

h) Port engine was lying near Bay No.45 and found damaged due to severe impact and fire. Most of the blades were found broken from the root end. Rotor discs were also found shattered. Starboard engine was lying near Bay No.41 and also sustained damage due impact. It did not show signs of fire damage. In this case too, number of blades were found broken from near blade root. Engine accessories of both the engines were found detached. Both the engine rear portions alongwith thrust reversers were found damaged. Condition of thrust reversers indicated stowed position.

i) Nose landing gear attachment was found detached from main structure. Upper and lower drag brace links were found damaged and came out from the main structural fitting. Both the nose steering actuators were found in damaged condition. Nose landing gear locking mechanism was found in broken condition. In the port main gear assembly, one of the tyres had detached and the corresponding brake assembly found stripped open, while other was found damaged due to fire. Walking beam was found attached with the landing gear,however, it came out from

the main structure. Oleo strut and locking mechanism were damaged. Side strut found collapsed. Starboard landing gear system disintegrated. Oleo pison broke into two parts. One of the tyre was found burst. Side strut was partially collapsed and the drag brace was intact. Walking beam was found separated both from main structure and landing gear. Both the main and nose landing gear actuators were found in fully extended position indicating that all the three gears were in fully retracted condition at the time of accident.

j) The cargo door which is located on the left side of the fuselage just aft of the forward entry door, was severely buckled and exhibited extensive scrapping in the aft direction.

k) **FLIGHT CONTROLS**

As the aircraft structure had dis-integrated into pieces upto the rear portion, on the flight control linkage pieces, no useful observation could be made. However, in the tail portion, the cables actuating the rudder PCU were found connected and functioning.

TRAILING EDGE FLAPS

Out of eight flap screw jacks, seven were located(No.1, 3,4,5,6,7 and 8). No.2 flat screw jack could not be located as it probably mixed with the Aeroflot wreckage.

LEADING EDGE FLAPS

All the four L.E.flap actuators have been identified.

LEADING EDGE SLATS

Out of six actuators, only five could be retrieved. Actuator No.4 & 5 are intact while another three are in broken condition and could not be identified as for their position due to peeling off of its name plates during the crash. The untraced actuator is probably mixed up with the Aeroflot wreckage.

SPOILERS

Spoilers No.(s) 6,7 & 8 were attached to starboard wing and found flush with the surface. Leaving one inboard ground spoiler actuator, all other spoiler actuators were recovered. Piston extension measurements indicated that spoilers were in fully retracted condition.

AILERONS

Both the aileron PCU's were recovered and were found to be detached and in damaged condition due to impact and fire.

HORIZONTAL STABILIZER

The screw jack was found intact and its ball nut was found jammed in position.

ELEVATOR

Both of the elevator PCU's were found in damaged condition in fully retracted position. The feel and centring springs and feel actuators moved smoothly and normally.

RUDDER

Rudder was found intact and attached to the vertical fin. The cables were found connected to the quadrant and further linkage was intact in the tail portion. Both, main and standby rudder PCU's were found intact. No abnormality was observed. By cable movement, linkage could be operated upto power control units.

1.13 **MEDICAL AND PATHOLOGICAL INFORMATION**

Post mortem of the dead bodies was carried out at Safdarjung Hospital. Bodies of all the four crew members were found in disfigured, mutilated and in burnt condition. The major portion of the body of the Captain was found the next day with the Aeroflot wreckage in extensively burnt condition. Two Aeroflot personnel had suffered fatal burn injuries. While other two personnel of Aeroflot who had also suffered burn injuries, died later at Safdarjung Hospital, New Delhi. The Bharat Petroleum contractor, who suffered burn injuries also died at Safdarjung Hospital. In addition, four persons received the burn injuries for which they were attended to.

1.14. **FIRE**

IGI Airport is managed by International Airport Authority of India. This airport is equipped with category IX fire fighting services, which cover heavier aircraft like Boeing-747 category. There are three fire stations i.e.Main Station located near 'D' Taxi Track, Sub Fire Station-I close to domestic apron and Sub Fire Station-II close to

the International Apron. There are 6 Crash Fire Tenders, two water tenders, one highlight platform and 3 Ambulances. There are 15 static tanks of different capacities at different locations at the airport. Static tank No.9 and Static Tank No.11 are located near the accident site.

A Group was Constituted by DGCA to examine the fire fighting aspects and a detailed report in this regard was prepared. Following are the salient observations from the report:

1. Aircraft accident took place at 1454 hrs IST at the International Terminal Apron (Apron-II) of Delhi Airport.

2. The aircraft disintegrated during the crash and wreckage hit the Aeroflot aircraft parked on Bay No.45. The wreckage of aircraft was spread over the apron area. There was fire all over the apron on the scattered pieces of wreckage and intense fire on the Aeroflot aircraft.

3. The Control Tower had sounded the siren immediately.

4. IAAI Apron T-II Assistant Airport Manager had transmitted on R/T that Sahara India Airlines aircraft has crashed at Terminal II Apron.

5. Some Main Fire Station personnel had seen the aircraft coming down and they immediately swung into action.

6. Initially, the Crash Fire Tenders from Sub Fire Station-II which is located near Apron T-II reached the crash site followed by Main Fire Station and Sub Fire Station-I. The fire fighting vehicles from the IAAI Fire Fighting Training school located adjacent to Airport also reached the site of crash. Fire fighting action began in about three minutes after the crash time.

7. Air Force Station Palam Domestic Fire Tenders and a water tender also reached the site of crash at 1510 hrs and assisted IAAI fire fighting services. Water was also supplied to Airport Crash Fire Tenders.

8. The Delhi Fire Services received the information at 1505 hrs IST and the fire fighting vehicles reached around 1520 hrs IST. Nineteen water tenders and 2 ambulances along with other equipments participated in the fire fighting. About 125 Officers and men of Delhi Fire Services with units participated in this operation.

9. The IAAI Airport fire fighting vehicles were supported by Delhi Fire Services, Air Force Station Palam for water supply from their water tenders. The continuity of water supply was maintained through the static water tanks at the airport.

10. The total time taken to control the fire was about 43 minutes (1457 hrs IST to 1540 hrs IST) as per IAAI log books. However, as per Delhi Fire Services, the fire was under control at 1615 hrs.

11. Though fuselage of the Aeroflot was completely charred, the spread of fire on to the wings was checked which contained about 50 tonnes of fuel.

12. Number of vehicles and ground equipment were destroyed in this fire. Also, apron area and three aerobridges suffered damage. There were nine casualities and 4 persons suffered injuries.

13. On the date of accident, the Airport Authority Fire Services had 35,000 ltrs of water, 400 Kgs of DCP and 500 Kgs.of BCF. Total of 42 Fire Fighting Personnel were on duty.

14. There was no mobile water replenishment arrangement for the CFTs positioned for the fire fighting resulting in dislocation of CFTs from ideal position to collect water from Static Tank No.9 & 11. Thus the fire fighting operation was carried out in stages.

15. The quality of the produced foam through the CFTs of IAAI was not standard and the fire extinguishing media was not creating required actions at the fire to combat, as stated by their fire officer.

16. On two Crash Fire Tenders of IAAI, the monitor controls was unserviceable and on other two Crash Fire Tenders, these monitors became unserviceable during fire fighting operation. Side channels for fire fighting were used on these crash fire tenders. The jet throw through the monitor did not cover the specified distance and CFTs were repositioned to the close vicinity of fire in the danger zone.

1.15 SURVIVAL ASPECT

The log book of Sub Fire Station II and that of the Fire Officer indicates that six dead bodies were recov-

ered from the wreckage. The bodies of Sahara India Airlines crew had disintegrated and exposed to fire and were lying scattered near Bay 45.

Around 1515 hrs. two injured persons Shri Ravinder and Shri Ikrar Ali of Oberoi Flight Kitchen were rescued from the site and were sent to casualty centre at terminal-1. From there they were sent to Ram Manohar Lohia Hospital.

Five more injured persons by name S/Shri B.P.Mashi of Bharat Petroleum Corporation, Damodaran of Aeroflot, A.Nikolai of Aeroflot with severe burns, Chagan Lal of IAAI and Gautam Chatterjee of Oberoi Flight Kitchen with multiple injuries were sent to Safdarjung Hospital. Out of these persons Shri D.P.Mashi, Shri Damodaran and Shri Nikolai succumbed to their injuries in the hospital. Following are the extracts from Log Book of MI Room, Terminal II, as recorded by Dr.Mahajan:

Mr.B.P.Mashi, Bharat petroleum - almost 80% burns all over the body.

Mr.Damodran, Aeroflot-almost 80% burns all over the body.

Mr.Analdi Nikolai, Aeroflot - almost 80% burns all over the body.

All the above three patients were given a wet saline

cleaning, then wrapped in blankets and given injections, stabilised and sent for Safdarjung Hospital at 1515 hours.

The other two casualities brought to Terminal II MI Room were Shri Chagan Lal of IAAI who had received a clean laceration wound on forehead and Shri Gautam Chatterjee of Oberoi flight service were also sent to Safdarjung Hospital.

1.16 TEST AND RESEARCH

1.16.1 FLIGHT CONTROLS

a) GENERAL

The Boeing 737 aircraft features a powered flight control system which has aileron and flight spoilers for lateral control(roll), elevators and movable horizontal stabiliser for longitudinal control(pitch), rudder and yaw damper for directional control(yaw), speed brakes for flight and ground aerodynamic braking and high lift devices to provide lift at the lower speeds for take-off and landing.

Primary flight controls(ailerons, elevators, rudder) are powered by hydraulic systems 'A' and 'B'. Either of hydraulic system, alone, can power any primary

control surface. In the event that both hydraulic systems 'A' and 'B' become unavailable, the aileron and elevator controls revert to a mechanical manual reversion backup system and the rudder is powered by the standby hydraulic system.

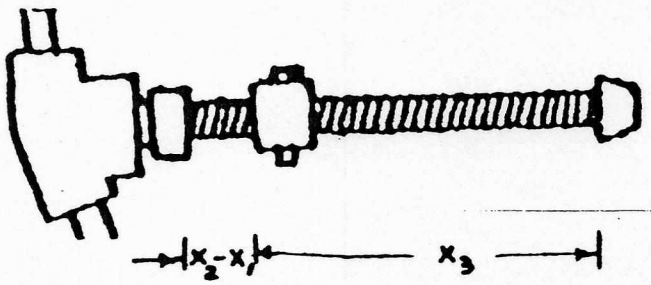
b) **EXAMINATION**

A group was constituted by DGCA to examine into flight controls. Following are the salient observations from the report.

i) **TRAILING EDGE FLAPS**

The system consists of four flaps, two on each wing which are operated hydraulically through mechanical transmission. Each flap has two flap screw jacks. Thus there are a total of eight flap screw jacks.

Three flap screw jacks(No.6,7 and 8) on the starboard wing were found intact. No.5 flap screw jack, which was not intact, was identified from the part number. Three screw jacks(No.1,3 and 4) were identified from their orientation and attachment. No.2 flap screw jack could not be located. The measurement of various recovered screw jacks of accident aircraft, as record-ed, are given below;-



Screw Jack No.	1	2	3	4	5	6	7	8
Dimension- (inch)	X2-X1			25.25		25.258		
	X3 (inch)	5		6		7	6.25	4.6

The flap screw jack measurements on the accident aircraft are quite close to the Flap 15 configuration when compared with the dimensions provided in Boeing 737 Control Position Data Document No. D6-19512-1 Rev. 'D'.

ii. **LEADING EDGE FLAPS**

There are four L.E.flaps, two each on starboard and port wings. All the four L.E.flap actuators have been identified. Actuator No. 1 & 3 are intact while No.2 $ 4 are in broken condition. During leading edge flap extension, the actuator extension is about 7.95 inches. In the accident aircraft case, the extension of No.1 & 3 actuators was also found to be about 7.9 inches. Thus the leading edge flaps were fully extended at the time of accident.

iii. **LEADING EDGE SLATS**

There are six leading edge slats three on each side which are actuated hydraulically by six actuators. Out of six actuators, only five could be retrieved. Actuator No.4 & 5 are intact while another three are in broken condition and could not be identified as for their position due to breaking away of the name plates. From the physical observations of the retrieved actuators, it may be concluded that the same were fully extended.

iv. **SPOILERS**

There are eight spoilers, four on each wing. No.1,4,5 & 8 are ground spoilers while No.2,3, 6 & 7 are flight spoilers. Ground spoilers No. 4 & 5 have two actuators each while other spoilers has only one actuator.

Spoilers No.(s) 6,7 & 8 are attached to starboard wing and found flush with the surface. They are badly burnt. Piston extension measurements of the rest of the spoiler actuators also indicated that the spoilers were retracted at the time of crash.

v. **AILERONS**

There is one aileron on each wing operated by two power control units (System 'A' and System 'B'). Both the aileron PCU's were recovered and were found to be

detached and in damaged condition due to impact and fire. The aileron trim gearbox was found in jammed condition in near neutral position. One of the aileron PCU's(lower) actuator extension is 1.125 inch corresponding to port aileron deflection about 9 degrees down. Another PCU(upper) actuator extension is 0.25 inch corresponding to starboard aileron deflection of about 16 degrees up. Both the left and right aileron drive quadrants were found badly damaged. Drive cables were found separated and curled up. The left aileron quadrant was found jammed in counter clockwise direction with the push rod to aileron broken. No positive conclusion could be drawn from the above observations.

vi. **HORIZONTAL STABILIZER**

The horizontal stablizer can be moved by motor operated screw jack. The screw jack was found intact and its ball-nut was found jammed in position. The measured position of the ball nut corresponds to about 7 units up (within green band of take-off configuration) as confirmed on the serviceable aircraft.

vii. **ELEVATOR**

Both the elevator PCU's were found intact and in fully retracted position. The feel and centring springs and feel actuators moved smoothly and normally. The fully

retracted position of both the PCU's indicate elevator 'up' position. However, in view of impact forces, it cannot be said that this was the elevator position prior to impact.

viii. **RUDDER**

Rudder was found intact and attached to the vertical fin. Both, main and standby rudder PCU's were found intact. When the main PCU is in operation the standby idles. The actuator extension of main PCU was 2.25 inches while that of standby actuator was 2.8 inches. As checked from the Document No.D6-19512-1 Rev 'D' of Boeing Co. regarding '737 aircraft control position data', the above measured actuator lengths indicate that the rudder was deflected towards right about three and a quarter degrees. However, in view of impact damage to the aircraft and its controls, the exact position of the rudder prior to crash could not be positively concluded.

Functional check of main rudder PCU and auxiliary PCU were carried out. All the tests on main rudder PCU were carried out satisfactorily except the transducer null voltage test wherein the null voltage was observed to be 185 mV as against a maximum limit of 150 mV. Tests on auxiliary rudder PCU were also satisfactory

except servo valve neutral position test which was found to be marginally out of limits. With this variation the units will still remain functional.

EXAMINATION OF UNDERCARRIAGE

Nose landing gear attachment was found detached from main structure. Upper and lower drag brace links were found damaged and came out from the main structural fitting. Both the nose steering actuators were found in damaged condition. In the port main gear assembly, one of the tyres was found missing and the corresponding brake assembly found stripped open. While other was found damaged due to fire. Walking beam was found attached with the landing gear, however, it came out from the main structure. Oleo strut and locking mechanism were damaged. Side strut found collapsed. Starboard landing gear system disintegrated. Oleo piston broke into two parts. One of the tyre was found burst. Side strut was partially collapsed and the drag brace was intact. Walking beam was found separated both from main structure and landing gear. Both the main and nose landing gears had extensive fire damage. Both the main and nose landing gear actuators were found in fully extended position indicating that all the three gears were in fully retracted condition at the time of accident.

SUMMARY:

i. Trailing edge flaps were selected to 15 degrees position.

ii. Leading edge flaps were fully extended.

iii. Leading edge slats were in extended position.

iv. Horizontal stabiliser was at about 7 units of trim.

v. Ground spoilers and flight spoilers were fully retracted.

vi. Rudder main and standby PCUs were found functionally satisfactory during the bench check.

vii. Due to the extensive damage to the aileron and elevator PCUs, no conclusion could be drawn.

viii. Landing gears were fully retracted.

1.16.2 ENGINES

a) GENERAL

Engines fitted on this aircraft are Pratt & Whitney JT8D-17. JT8D engine is an axial flow front turbofan

engine having 13 stage spilt compressor, a nine can-annular combustion chamber, and a split four stage reaction impulse turbine. The engine is equipped with a full length annular fan discharge duct. The low pressure system is made up of the front compressor rotor and the second and third and fourth stage turbine rotors and is mechanically independent of the high pressure system which consists of the rear compressor rotor and the first stage turbine rotor. The engine is mounted from two points. The front mount is located at the fan discharge intermediate case. The engine rear is located at the turbine exhaust section outer duct. JT8D engine has got number of models which are basically same except some physical differences depending upon incorporation of the change. The dry weight of the JT8D-17 engine is 3340 lbs. and has take-off thrust of 16,000 lbs below 28.9 degrees C.

b) **EXAMINATION OF THE ENGINES**

A Group was constituted by DGCA to examine the engines. Following are the observations from the report:

Port Engine

Type of Engine	P & W JT8D-17
Serial No.	688198
Constructor's Name & Address	PRATT & WHITNEY
Time Since New (Hours)	24578

Cycles Since New	10701
Time Since Overhaul (Hours)	3165
Cycles Since Overhaul	1545

The strip examination was carried out at M/s.Indian Airlines Jet Shop.

FINDINGS

1. Appreciable damage was observed at engine inlet ara No.1 bearing housing was found missing. The LPT shaft was bowed at about 6 O'clock position with front end up. In the low pressure compressor region most of the rotor blades were found sheared from the root. Those attached were broked at the root end and bent in a direction opposite to the direction of rotation. The 3rd, 8th and 9th stage rotor disks were found sheared circumferentially near the rim. LPC stator vanes were found in pieces. 8th and 9th stage stators and seal spacers were also found badly damaged. Condition of 13th stage disk were found satisfactory and most of the blades were damaged and bent opposite to direction of rotation. 3rd stage turbine blades were found bent opposite to the direction of rotation.

2. All the fuel nozzles were found in position. There was no sign of burning on the fuel manifold and no cocking was observed on any of fuel nozzle. Condi-

tion of all the combustion chambers from inside was found satisfactory. There was no sign of oil streaking or burning or metal spattering. First stage NGVs were found in satisfactory condition. No symptoms of fire were observed in the hot section area. No fused metal was observed in the turbine stages.

CONCLUSION

1. Condition of the fan rotors, low pressure compressor and bend in the low pressure turbine shaft indicates that a severe impact suffered by the engine.

2. There is no indication of any engine fire.

3. No evidence of foreign object which could affect the performance of the engine was observed in the gas path area.

4. The physical condition of the engine parts investigated confirmed that the engine rotors were rotating at a higher speed at the time of impact.

5. The three engine mount provisions appeared to be intact before the engine impacted at the crash site.

6. No hot section distress was observed.

7. Determination of Engine Pressure Ratio (EPR)

is not possible from the physical examination of engine hardware.

STARBOARD ENGINE

Type of Engine	P & W JT8D-17
Serial No.	702652
Constructor's Name & Address	PRATT & WHITNEY
Time Since New (Hours)	23722
Cycles Since New	20037
Time Since Overhaul (Hours)	13182
Cycles Since Overhaul	11280

FINDINGS

Appreciable damage ws observed at engine inlet area. Bolt holes of visible compressor rotor disks were elongated. Most of the compressor rotor blades were found sheared and those available were bent opposite to the direction of rotation. Compressor stator vanes were observed to be bent in the direction of rotation. In 3rd stage about 50% of rotor disk was found broken with circumferential crack of 60 degree. The 4th stage dove tail shroud was found damaged/pressed all round periphery. In the turbine 4th stage available blade portions were found bent in anti clockwise direction and had rub marks at their convex area. Also in the 3rd stage NGV's rub marks were observed at the trailing

edge. However, no symptom of fire or fused metal deposit was observed.

CONCLUSION

1. There is no indication of any fire on the engine.

2. The condition of the rotating parts indicated that the engine rotors were running at a higher speed at the time of impact.

3. All the damages/breakages on the engine external parts were purely due to external impact on the engine.

4. All the three engine mounts provisions appeared to be intact until the engine impacted at the crash site.

5. No hot section distress was observed as viewed with the help of boroscope to the extent possible.

6. Determination of Engine Pressure Ratio (EPR) is not possible from the engine hardware.

1.16.3 **SPECTRUM ANALYSIS OF THE ALTITUDE ALERT AND UNSAFE LANDING CONFIGURATION HORN AS RECORDED IN CVR.**

During the reply of the CVR tape, it was observed that a horn of unsafe landing configuration had sounded at reference time 34.44 and altitude alert horn at reference time 17:42. To confirm that these horns were truly the unsafe landing configuration horn and altitude alert horn respectively, comparative spectrum analysis of the horn sounds, as recorded in the CVR and Laboratory recorded true horn sound, was carried out at DGCA laboratory and then at the facilities of National Aerospace Laboratory, Bangalore and Bhabha Atomic Research Centre, Bombay.

The details of the frequencies of altitude alert horn and unsafe landing configuration horn were obtained from Boeing Co. The details of the frequencies are as follows:

i) ALTITUDE ALERT HORN

The altitude alert warning sounds one to two seconds when the airplace approaches a selected altitude either in ascent or descent. The warning horn is a 'C' chord and has three frequencies of 512 Hz, 640 Hz and 768 Hz with a tolerance of ± 5%.

ii) UNSAFE LANDING CONFIGURATION HORN

The unsafe landing configuration warning horn sounds continuously until the condition is clear. It

has a single frequency of 250 Hz with a tolerance of ± 15%.

The extract of the reports are as follows:

i. **BHABHA ATOMIC RESEARCH CENTRE RESULT**

i) The horn sound at 17:42 and the Lab altitude alert horn sound are close to each other with a 8.5% decrease in the CVR signal frequency spectrum shift.

ii) The horn sound at 34:44 and the Lab unsafe landing configuration horn sound are close to each other with a 3% increase in the CVR signal frequency spectrum shift.

ii) **NATIONAL AEROSPACE LABORATORY**

Spectrum of Lab recorded altitude alert horn showed prominent peaks at 517 Hz, 647 Hz and 777 Hz and spectrum of horn recorded in CVR at reference time 17:42 showed prominent peaks at 478 Hz, 599 Hz and 720 Hz. A constant ratio of 1.08 between corresponding spectral peak locations was observed.

Spectrum of Lab recorded unsafe landing configuration horn showed prominent peaks at 292 Hz, 585 Hz and 877 Hz and spectrum of horn recorded in CVR

at reference time 34:44 showed prominent peaks at 305 Hz, 600 Hz and 915 Hz. A constant ratio of 1.04 between corresponding spectral peak locations was observed.

iii) **DGCA LABORATORY**

The report confirmed that the altitude alert horn appeared at reference time 17:42 with a frequency variation of 9.2% and that of unsafe landing configuration at reference time 34:44 with frequency variation of 14%. The frequency variations are within limits.

In all the three reports, the horn at reference time 34:44 confirmed to be of unsafe landing configuration and that at reference time 17:42 as that of altitude alert.

Note: Reference time 34:44 is 09:23:26 UTC as seen in the CVR Tape Transcript.

1.17 ADDITIONAL INFORMATION

1.17.1 LOGICS FOR AURAL INDICATIONS IN CASE OF UNSAFE LANDING CONFIGURATION

Following is the extract from the Boeing 737 Aircraft Operations Manual regarding warning horn for unsafe landing configuration:

AURAL INDICATIONS - ADVANCED AIRPLANES

The warning horn is provided to alert the pilots any time the airplace is in a landing configuration and the gear is not down. The warning horn is activated by flap and thrust lever positions and low engine EPR.

With the landing gear not down and locked, the aural warning system provides a steady horn as follows:

- With the flaps 1 to 10, any time either or both thrust levers are retarded to IDLE. The horn can be silenced (reset) with the horn cut-out switch.

- With flaps 15 or 25 and either, but not both, thrust levers retarded to IDLE. The horn can be silenced (reset) with the horn cutout switch.

- With flaps 30 to 40 regardless of thrust lever position or engine EPR. The horn cannot be silenced.

1.17.2 STALL WARNING SYSTEM

Following is the extract from Boeing 737 Operations Manual regarding the Stall Warning System:

STALL WARNING SYSTEM

Warning of an impending stall is required to occur a minimum of seven percent above actual stall speed. Natural stall warning (buffet) usually occurs at a speed prior to stall. In some configurations the margin between stall and stall warning (buffet) is less than the required seven percent. Therefore, an artificial stall warning device, a stick shaker, is utilized to provide the required warning.

The stall warning system or "stick shaker" is designed to alert the pilots before a stall develops. The warning is given by vibrating both control columns. The system is energized in flight at all times. The sytem is deactivated on the ground by the airground safety sensor.

The stall warning system consists of a control column shaker (eccentric weighted motor), a heated angle of airflow sensor, a flap position sensor, a stall warning amplifier, the air-ground safety sensor and a stall warning panel on the aft overhead panel.

7.3 HANDLING THE AIRPLANE WITH AN ENGINE INOPERATIVE

Following is the extract from Boeing 737 Operations Manual under the topic "Engine Inoperative Familiarization" regarding handling the airplane:

1. Establish or maintain control of flight path and airspeed, in other words, "fly the airplce".

2. **RUDDER AND LATERAL CONTROL**

To counter the thrust asymmetry due to an engine failure, compensate for yaw with rudder. Rudder application should always be smooth and at the same rate as thrust changes.

Under instrument conditions the instrument scan is centered around the attitude indicator. Roll is usually the first indication of an asymmetric condition. Roll control (ailerons) should be used to hold the wings level or maintain the desired bank angle. The rudder should be applied to approximately center the wheel.

Make turns at a constant airspeed and hold the rudder displacement constant. Do not attempt to coordinate rudder and lateral control in turns. Rudder pedal inputs will excite roll due to yaw and induce the pilot to counter his own rudder oscillations with opposite control wheel.

ISSUES INVOLVED

Before dealing with the vital issues/aspects to be examined in the enquiry, the issues/aspects in respect of which there can neither be any controversy nor there is one, namely sabotage and weather conditions may first be dealt with.

SABOTAGE

During investigation the wreckage was examined by a group constituted for the purpose of finding out the explosion/sabotage being the cause of the accident. The disintegrated parts of the aircraft were examined with a view to find out whether the crash was due to any explosive device or not. The sailent observations of the group report are:-

1. The fragments/debris materials may have curling/ringlet effects and spike toothed fractures on metal surface. These characteristics have not been observed in any part of the wreckage.

2. The incident of an explosion, the fragment will strike the surface at a glancing angle and produce gouge marks in the surface. No such gouge marks were noticed on the recovered main wreckage.

3. Due to the hot detonation gases, melting and erosion on the surface of the metal is possible which is termed as 'gaswash'. The debris/wreckage found in heavily melted condition is not due to detonation gases, but may be due to excessive heat generated during the fire.

4. Cupping and dishing in the near vicinity metal surface is a very common phenomenon with high explosive detonation, which is not observed on examination of the wreckage.

5. There is possibility of embedding the high velocity fragments in rubber foams/cushions during an explosion. The recovered cushion seats were examined to find out penetration holes of fragments/embedded fragments. No such sign of penetration have been noticed.

6. No part of bomb such as battery, wire, portion of detonators etc were recovered.

7. On detailed inspection and investigation of the wreckage debris of the crashed aircraft, no characteristic evidence of an explosion such as fragmentation, curling/ringlet effects, spike toothed structure of metals, gas washing, pitting and rolled edges have been noticed. No sign of cupping/dishing of

metal surface is seen. No positive characteristics of a mid air explosion were observed from the wreckage/debris examined.

In view of above, it is concluded that crash in question did not occur due to sabotage or explosion.

WEATHER CONDITIONS.

The metrological information/reports supplied by the Met Office of Delhi (Palam) indicate that there was no significant weather at Palam around the time of the accident. The aircraft was on visual circuit and landing. The following weather existed at Palam around the time of the accident:-

	1400 hrs IST	1430 hrs IST	1500 hrs IST
Surface wind	310/12	300/12	290/18
Visibility	6 Km	8 Km	8 Km
Cloud	Scattered 20,000 ft.	Scattered 20,000 ft	Scattered 20,000 ft
Weather	No Sig.	No sig.	No Sig.
Temperature/ Dew Point (deg C)	27/07	28/06	27/06
QNH	1014	1013	1013

It is evident from the above that during the period of training flight the visibility was around 8 Kms and the weather was very fine and it did not contribute directly or indirectly to the accident. The weather condition in Delhi was, therefore, not the cause of the accident.

VITAL ISSUES

The vital issues/aspects to be examined in the inquiry, as also agreed to by the participants, were formulated as under:-

1. System failure; and/or
2. Crew error; and/or
3. Regulatory and control functions of DGCA, NAA and IAAI.

FACTUAL ASPECTS

With a view to understand the aforesaid aspects let me first notice, the factual aspects in respect of which either there is no dispute or which have been fully established, as follows:-

1. Sahara an Air Taxi Operator started its operations in India in December 1993 with two Boeing 737-200 Aircrafts and one of it was VT-SIA Serial No.21763. This aircraft was airworthy as per Certificate of

Airworthiness.

2. The aircraft operated the flight Delhi-Bangalore-Delhi on 8th March 1994 uneventfully and landed at Delhi Indira Gandhi International Airport at 13.20 IST.

3. On 7th March 1994 Capt.V.N.Arora, Chief Operations Manager of Sahara arranged for a training flight for 8th March 1994. Capt.Parveen Khurana was to be the Instructor for the said training flight and Mr.P. Singh, Mr. Vidul Mahajan and Ms. Anshu Khurana were the trainee pilots. The training flight was planned for 13.30 hours on 8th March, 1994.

4. As per flight plan the duration of the local training flight was 2 hours and it included circuits and landings. Before start of the flight Pilot-in-Command told Air Traffic Control of the intention to carry out 9 circuits and landings.

5. All the 4 crew members had undergone Pre-Flight Medical Check Up and nothing adverse had been noticed.

6. The aircraft had 15 tons of ATF on commencement of the flight. The take off weight was 46720 Kgs which was also the maximum permissible landing weight.

7. There was no significant weather at Palam

either before commencement of the flight or at any time thereafter till the accident.

8. The aircraft was on visual circuit and landing. The runway in use was 28. The navigation and communication aids at the Airport were serviceable and functional during the flight.

9. The aircraft got airborne for the first time at 042 UTC with Capt.P.Khurana as PIC/Instructor and the 3 trainee pilots. This take off was executed by the PIC.

10. The aircraft then carried out 5 touch and go landings at 0851, 0857, 0907, 0914 and 0923 UTC. The first three touch and go landings were with trainee pilot P.Singh and the next two with trainee pilot Vidul Mahajan. The aircraft was in continuous two way contact with ATC from the time of start at 0832 UTC till about 0921 UTC i.e. upto about 2 seconds prior to the accident. During this period of the flight or even upto the time of the accident, there was no transmission to the ATC of any observed abnormality or of any anticipated/real emergency.

11. The aircraft was observed to be in normal flight after 5th touch and go upto about 400 feet height. Then it suddenly started turning left with port-side bank, which was increasing. The aircraft lost height and plunged

to the ground. The accident occurred within I.G.I.A. Airfield, Delhi and near Apron II at about 0924 UTC. The crash siren was sounded promptly by ATC, even as Aircraft was impacting the ground.

12. The CVR transcript does not indicate of any prior caution to the trainee pilot any time before the accident that the port engine was being retarded to idle after the 5th touch down to simulate single engine conditions.

13. UFDR data indicates EPR-I value coming down to 'idle' value after the 5th touch-down and before accident.

14. All 4 crew members of Sahara aircraft and also 4 other working in the Aeroflot aircraft in addition to one Bharat Petroleum employee died as a result of the accident. Three employees of the Oberoi Flight Kitchen and an IAAI Contractor also suffered some injuries. As a result of the accident both the aircraft were totally damaged due to impact and fire.

15. The three trainee pilots had undergone simulator training in Boeing 737-200 simulator in British Caledonian in December 1993, January 1994 under Capt.R.N.Rao. They had been given CA40(A) Check by Capt. V.K.Sharma and were declared successful.

16. Capt.Khurana joined Sahara on 3rd November 1993. He had earlier been approved as Check Pilo in Boeing 737-200 while in service in Indian Airlines and Modiluft but did not ever exercise the privileges of a Check Pilot before being employed by Sahara.

17. Capt.Khurana was approved as Check Pilot by DGCA vide their letter dated 24th December 1993 and Instructor vide letter dated 8th March 1994.

18. The fateful flight of 8th March 1994 involved first ever training flight conducted by Sahara; the first ever instructional flight provided by Capt. Khurana and the first 737 Boeing Flight flown by the three pilots in actual aircraft.

19. The accident took place during third and final take off and landing circuit of Vidul Mahajan. According to the CVR Vidul Mahajan rotated the aircraft for a final take off at UFDR Time 2904.

SYSTEMS FAILURE

As the use of the word the 'Systems' itself suggests, the ambit and scope of enquiry under the head 'Systems Failure' is very wide. It includes the examination of failure of aircraft or any part thereof, failure of

management, failure of manufacturer of aircraft, failure of maintenance, failure of airport authorities, failure of regulatory body or any other organisation/system. All these aspects of failure of systems other than that of failure of aircraft or its part would be examined and dealt with, for the reason and sake of convenience, in the later part of this report, while dealing with the third issue namely of 'Regulatory and Control Functions of DGCA, NAA and IAAI.'

Before dealing with the aspect of failure of part(s) of aircraft, let me notice the type of CVR & UFDR fitted on the aircraft and also certain matters relating thereto.

CVR

The fare child Cockpit Voice Recorder(CVR) Model No.A-100 bearing Sl.No.3298 was fitted on the aircraft. This CVR has megnatic type recording on 4 channels. Channel No.1 is for Observor, Channel No.2 for First Officer, Channel No.3 for Captain and Channel No.4 for Area Mike. The recording information for last 30 minutes is retained. The CVR had suffered impact and fire damage. It was opened at CVR Laboratory of DGCA. On opening inner metalic casing and tape assembly were found intact. The tape remained protected in the armoured unit and its condition was also found satisfactory. The tape was taken out and it was replayed at DGCA Laboratory. Initially reference time was given during the preparation of tape transcript and

then with the help of ATC transcript, reference time was converted into universal coordinated time (UTC). The relevant CVR tape transcript is Annexure "A" to this report. The UtC time in Annexure "A" were achieved by corelating full 30 minute detailed record on CVR.

UNIVERSAL FLIGHT DATA RECORDER (UFDR)

The parameters recorded in the UFDR fitted in the aircraft have already been noticed in earlier part of this report as also the facts about external damage suffered by the outer casing of this unit and also facts about the data retrieved at M/s.VSM Aerospace Facility at Bangalore and at National Aerospace Laboratory, Bangalore. On perusal of the data decoded at the said two laboratories it was considered necessary to get the data further refined at the laboratory of National Transport Service Board, Washington who had long experience in the field. The Unit was accordingly taken to Washington, USA and Mr.Dannis R.Grosy and Mr.Elfard W.Dickenson participated in the meetings for analysis of the data and for read out from the tape of the UFDR Unit in question. Mr.Dennis worked on the UFDR Unit and transferred the data from the tape to the Computer and then processed it. The report of NTSB is Ex.6. The reference in this report to UFDR data, as was also done by learned counsel for participants during arguments, is to the data prepared by N.T.S.B., Washington, USA (Ex.6). The

relevant UFDR data is Annexure "B" to this report.

TIME CO-RELATION OF CVR,UFDR AND ATC TIMING

Time is not recorded on CVR. On UFDR frame counter readings are recorded every second. These counter readings are used as time counter. To achieve co-relation between CVR and UFDR, some specific points are required which can be identified on both CVR and UFDR. One of the standard methods used for co-relation is through the recording of VHF Keying parameter of UFDR. A transmission from aircraft to ATC requires the use of Press-to-Talk (PTT) switch. The UFDR records the use of PTT switch and this parameter is known as VHF Keying. With the identification of the transmissions to ATC recorded on the CVR, it is possible to co-relate CVR transmissions with UFDR recordings. With the same method, the CVR recordings and ATC recordings can be corelated. The ATC recordings have a time channel which records time in UTC. The time of ATC is normally co-related to CVR and UFDR as it is a real time clock.

As noticed above, the corelation of time as given in CVR Transcript (Ann.'A') and as given in the earlier part of this report in relation to EPR values only was on the basis of a full 30 minute period recorded on the CVR. It was,however, felt essential to obtain more accurate corelation which was possible if the UFDR data and CVR transcript is required to be co-related for a crucial time

of one minute or so, inssead of relying upon co-relation done for 30 minutes. Accordingly, the co-relation of CVR transcript and UFDR data has been prepared as follows:-

A touch down sound of the 5th landing has been recorded on CVR which is at 09:22:55 UTC. This touch down can also be normally identified on the 'vertical acceleration' parameter recorded on UFDR. The vertical acceleration is recorded 8 times in a second. UFDR read out shows that touch down was between frame No. 2888 and 2889 during which the vertical acceleration has a maximum peak of 1.35 G. This touch down point in the co-relation chart has been taken as 0 second and all other timings (in seconds) are from this touch down point. This co-relation chart is Annexure 'C' to this report. For better understanding the frame number of UFDR read out have been incorporated in another co-relation chart which is Annexure 'D' to this report.

To get more accurate time on CVR transcript in aforesaid charts for CVR recordings of about 50 seconds were stored in 5 frames of 10 seconds each in spectrum analyser and the touch down was used to determine the exact timings of the CVR call outs.

CRASH POINT

In CVR the last touch down point after the 5th circuit and the crash point is clearly recorded. The time differences between the two events from the exact timings obtained by above method is 43.5 seconds. On UFDR touch down point is identified by the 5th recording of vertical acceleration peak of 1.3.5 G in frame No.2888 i.e. half frame. The last recording of UFDR is till end of frame No.2931 which contains all good recordings of vertical acceleration. Therefore, as per UFDR the time differences between touch down and last recording is (2932 minus 2888.5) 43.5 seconds. Instead of taking 2931, the figure 2932 has been taken since, as stated above, the recording till the end of 2931 contains all good recording of vertical acceleration. It stands clearly established that the time differences from touch down to crash point is 43.5 seconds.

ENGINE PRESSURE RATIO (EPR)

The fall in the value of EPR of the left engine also stands fully established from the material and data on record. None of the participants including counsel for Mrs.Khurana disputed the facts relating to

the fall of EPR value of the left engine. The decline in the left engine EPR started from UFDR Time 2909 and it continued for 5 seconds i.e. upto time frame 2914. In just 3 seconds (UFDR time frame 2910 to 2912) there has been about 30% drop in EPR value. During 5 seconds from 2909 to 2914 the aircraft developed a positive rate of climb and at UFDR time 2913 Capt.Khurana announced that he was putting the 'gear up". The EPR value of left engine is almost constant from UFDR time 2914 to 2917. The EPR value again started a drop from UFDR time 2917 and reached almost idle position at UFDR time 2921. At UFDR time 2919 the unsafe landing configration horn sounded. At UFDR time 2922 Capt.Khurana called "Rudder, Rudder, Rudder". The aircraft rolled severely to the left reaching an extreme of 101.9 degrees left wing down at FDR time 2923. Within about less than 2 seconds Capt.Khurana shouted "Na Na leave leave".

According to Mr. Mahajan, counsel for Mrs.Khurana, the drop in EPR was not on account of retarding the left engine thrust lever by Capt.Khurana but it was on account of fuel starvation as a result of mal functioning of Fuel Control Unit. According to other participants the drop in EPR value of left engine was on account of retarding of left engine thrust lever by Capt.Khurana.

F.C.U.

Mr.Mahajan suggests that the Fuel Control Unit of the left engine (Port engine) was not fully functional and the blockage of the fuel nozzles could have led to the drop of EPR value.

The aircraft had been subjected to 7C Check in USA in 1993 before it was flown to India. Further, the aircraft had been subjected to "C" check on 6th March 1994 and it is in evidence that at that time the fuel nozzes were cleaned. The Symptoms of Fuel starvation in an aircraft specially on take off stage, when full power is applied, are typical. No attempt has been made in evidence to bring out the typical symptoms of fuel starvation or of blocked nozzles. Neither the pilot nor the engineer witnesses have been asked specific and pointed questions on this aspect of symptoms of fuel starvation. If FCU was not functioning or was mal functioning, as suggested by Mr.Mahajan during submission, certainly there would have been some indications in the Cockpit. It is not so. The FCU is a condition monitored component. According to Mr.S.Krishnan the Quality Control Manager of Sahara, who appeared as a witness, the FCU is a condition monitored component and had had done 7280 hours since installation. Mr.Krishnan also stated that fuel nozzle

cleaning was done on 6th March, 1994 at the time of C Check. It is stated that it took about more than 300 man power to carry out the C check in which more than 40 persons were involved. According to Witness No.7 Mr.P.K.Chhatopadhaya also the Fuel Nozzle cleaning was carried out on 6th March, 1994 and that the Sahara possessed the necessary nozzle cleaning facility from the very inception of the organisation. The drop in EPR has been gradual. Had there been total sudden stoppage of fuel, it would result in abrupt drop of EPR value. On the other hand, if total stoppage of fuel inflow is not there but there is only a leakage of fuel, it would not result in the EPR value dropping to idle. In such an eventuality the drop in EPR can be set off by use of the throttle. The EPR has not dropped abruptly but gradually. It may also be noticed that while setting the take off power of an engine, the crew is required to open the throttle to the extent that gives the required take off EPR as per the atmospheric condition. There is no evidence to show that the engine did not develop the required power. If the Compressor Delivery Process(CDP) line was loose it would have created a leak which would have required the throttle to move further than that of Engine No.2 and there would certainly been a mention of it during the training flight. No such mention has been made. In this view of the matter the condition of 10 PSI(Pounds

Per Square Inch) of Engine No.1 and 11 PSI of Engine No.2 is of no consequence and is not indicative of looseness of CDP line causing drop in the performance. Regarding suggested mal functioning of P & D value by not tightening the input or output lines of the same by oversight, it has to be noticed that these lines handle fuel under a very high pressure and any loosenss will cause a very high fuel leak which cannot be missed and in absence of any indication of it the mal functioning of P & D value is ruled out. Further, such mal functioning would also affect the starting of the engine and there is no evidence to show that the starting of the engine was effected in any manner. There is also no evidence that there was any loud compressor soiled noise since the sudden blockage of CDP line would have resulted in such a noise which cannot be missed. No such sound has been recorded by CVR. The blockage and shearing of CDP line is ruled out.

The FCU was inspected by a Team of Experts at Calcutta. The FCU inspection report is Ex.3. The inspection had taken place nearly 4 months after the accident. The basis of submission of FCU malfunctioning is this report. It seems, however, clear that the FCU having been exposed to weathering as part of wreckage for over four months must have got somewhat further damaged. Even grass was formed inside it. It cannot be that FCU was in such a condition on 8th March

1994 during the flight. The FCU mal functioning on account of 3 D Cam wear/rusting during the course of Shop Test/Strip examination report (Ex.3) as noticed above, would have been on account of exposure for about 4 months. If the condition of FCU, when it was installed in the Aircraft, had been as mentioned in Ex.3, it would have certainly reflected in the performance of the engine and the behaviour of the engine would have been reported by the Pilots of the previous sectors. Nothing of the kind was done. The consistent operation of the engine prior to the crash suggests that there was no mal functioning of FCU attributable to 3 D.Cam. I may, however, mention that FCU being one of vital component should not have been left on site and ought to have preserved by the Inspector of Accidents to avoid its exposure to weather conditions.

Mr.Mahajan submitted that as per 'C' check schedule the removal and installation of P&D valves requires that serial number of the port and starboard valves should be inserted on the sheet at the time of removal as well as installation to ensure that there is no intermixing of valves of the port and starboard engine. Learned counsel also pointed out that here neither the 'off number' nor 'on number' has been entered during the 'C' check. It has further been pointed out that there is requirement of collection of

samples of engine oil and sending the same for chemical analysis and in this case no such finding with regard to result of such analysis has been recorded in the 'C' Check schedule which would be essential to monitor the possibility of a power failure of the engine. It is further pointed out that there is a requirement of 15 seals for the purpose of carrying out C Check. It is submitted that nowhere in the 'C' check schedule it has been stated whether the seals were actually procured and changed. It is submitted that at the time of installation of P & D valve in 'C' check seals have to be changed since the seals cannot be reused once the P & D valve is removed. It has been inferred that use of the old seals could certainly result in fuel leak/power loss.

Though there may be substance in the submission in regard to the maintenance of record as pointed out by Mr.Mahajan, but this only shows that the record as is expected to be maintained by the Operator at the time of carrying out 'C' check schedule was not properly maintained. Nothing more than this can be inferred particularly keeping in view the observations made hereinbefore that assuming there was leakage it would have affected the starting of the engine and there is no evidence to show that the engine was affected in any manner and also that the loose P & D valve would have been noticed since these lines

handle fuel under a very heavy pressure and looseness will cause a very high fuel leak which cannot be missed. Therefore, the non maintenance of the record properly during 'C' check schedule is certainly an irregularity but the same cannot be attributed as a cause of the accident.

RUDDER CONTROL UNIT.

Mr.Mahajan then contended that it is possible that rudder actuated piston in the aircraft may have gone in a direction opposite to the intended direction resulting in reduced controlability of the aircraft which may have caused the accident. If that was so there would certainly have been indication in the CVR about the mal functioning of rudder. The call "rudder, rudder, rudder" was made at UFDR time frame 2922 and the crash occurred at the end of UFDR time frame 2931. In this phase of 9 seconds or during about 8 seconds from the call 'leave, leave' to the time of crash there is nothing in CVR to suggest the mal functioning of rudder which is difficult to accept in case the rudder was mal functioning and going in a direction opposite to intended one.

Further the rudder PCU was examined in Indian Airlines facilities and the test was found satisfacto-

ry. In the said test, however, the dual servo valve manufactured by M/s.Parkar Henifin could not be checked. The unit was also sent to M/s.Parkar Henifen. The report of the said organisations establishes beyond doubt that there had been no reversal of rudder control. The report rules out any jam. In view of the fact that there was no jam and also bearing in mind other aspects noticed above, the fact that dual servo valve may have been changed by someone other than the manufacturer, (a fact which could not be ascertained on account of absence of the complete maintenance record of the rudder unit) in any case, does not show the mal functioning of rudder PCU. It is,therefore,concluded that the mal functioning of rudder PCU has not been established as a cause of the accident.

Two other aspects which were vaguely suggested by learned counsel Mr.Mahajan may be also dealt with here.

DISINTEGRATION

The first relates to disintegration of the tail portion and/or port wing from the aircraft in air at about 464 feet above ground level. In that regard it was also suggested that this disintegration would also explain the disruption of power supply to UFDR/CVR at the said altitude. Firstly, learned counsel is assuming the disruption of power supply to UFDR/CVR

when the aircraft was at about 464 feet above ground level. There is nothing to suggest that there was any such disruption. The theory of disintegration of the tail portion and/or port wing in air also does not find any support from the material on record. It may be noticed that G loads had not exceeded 1.7 G, which is well within the 'G' envelope of + 2 to - 1. The forces created on the ill fated aircraft will not be strong enough to cause disintegration. The speed was about 150 knots only. It is well below the maximum speed of 350 knots. Aileron reversal will take place at the maximum speed of about 350 knotes where the wing will twist because of maximum deflection. Further, the structural disintegration also does not suggest that disintegration took place in the air. The accident took place during the day light. The aircraft was noticed by the Staff at the Airport while it was in air. No eye witness has come forth to state that the aircraft disintegrated in air. The portions of the aircraft aforesaid were also found in the tarmac area of the Airport. If the aircraft had disintegrated in air these portions would have been found in a larger area and would not have been localised in the tarmac area. From all these accounts the disintegration of the aircraft in air is completely ruled out.

WAKE VORTEX

The phenomenon of Wake Vortex which affects the flow over the wings or control surfaces when one aircraft follows another aircraft has also no applicability to the present case. It has come in evidence that the Wake Vortex effects are more lethal when the aircraft is landing because of the low speed and this phenomenon ordinarily does not affect when the aircraft is taking off because the aircraft is at full power and its speed is rapidly increasing and aircraft is gaining height. The Sahara aircraft, being a medium aircraft, did not land behind any heavy aircraft. The only related air traffic was the take off by a medium aircraft i.e. Avro, which preceded the take off of the fateful aircraft by over 3 minutes. In the light of the provisions contained in ICAO DOC 4444 the time is longer than what is contemplated even where the preceding aircraft was a heavy aircraft. The applicability of the phenomenon of Wake Vortex as vaguely suggested by counsel for Mrs.Khurana is also ruled out.

CREW ERROR

Let me first notice the Crew Action.

The co-relation charts Annexure 'C' and 'D' which are accurate upto half a second show that:-

1) Immediately after the rotate call the pitch of the aircraft had started increasing;

2) Immediately after the call outs 'Nothing is happening' and 'Let us see what to do now', EPR of engine No.1 had started decreasing;

3) The positive climb call out shows that at that time the aircraft had attained the positive rate of climb;

4) When the 'Gear up' call out is given the EPR of Engine No.1 stopped reducing further;

5) The horn sound has been recorded around 30.5 seconds from the touch down (Frame No.2919) when the aircraft was 359 feet above ground level; (1111.9 minus 760);

6) Prior to the 'Rudder, Rudder, Rudder' call the aircraft was rolling to the left gradually and after the call 'Na, Na, Leave, Leave', the rate of roll has increased sharply;

7) The maximum roll was about 100 degrees(Minus 101.9 degrees at frame No.2928) which subsequently reduced to about 60 degrees(Minus 59.30 degrees at frame No.2930);

8) The aircraft attained the maximum height of 498 feet above ground level in about 37.5 seconds. from the touch down (Frame No.2926) and started descending thereafter;

9) The stick shaker warning started at about 39.5

seconds from touch down (Frame No.2928) and remained till the crash. At the time of initiation of stick shaker warning, roll angle of the aircraft was at its maximum of 101.9 degrees to the left and the pitch attitude was about 8 degrees nose down;

10) At the time of crash the speed of the aircraft was increasing and was around 150 knots. The attitude of the aircraft was about 19 degrees nose down and about 76 degrees to the left bank. The EPR of Engine No.1 shows slight increase in value.

In order to understand the crew action the aforesaid aspects would have to be kept in mind. I may also notice that the altitude reading on the UFDR shows that the aircraft was about more than 400 feet above ground level at Frame No. 2931. The altitude reading after Frame No. 2926 cannot be accepted as valid. Beside the reasons already noticed earlier, it has to be borne in mind that the values of the corrected roll angle recorded in the Frame No. 2926 have shown the increase in the left bank from 58.97 degrees to 81.12 degrees; the values of corrected roll angles in Frame No. 2927 shows a left bank of more than 90 degrees and these values show abnormal attitude and have probably affected the altitude value. The value of the altitude recorded in Frame No. 2926 is 1257.7 feet which is about 498 feet above ground level and is the maximum height gained by the aircraft. The crash is about 6

seconds later. The height of 498 feet was lost in six seconds. The average rate of decend during the period works out to be (498 x 60/6) equal to 4980 feet per minute. Further, the corrected roll readings recorded on the UFDR show that the aircraft has remained in that altitude of more than 90 degrees for 2 seconds i.e. during the Frame No. 2927 and 2928 and thereafter it has started recovering in the next two frames. It is,therefore, appropriate that the altitude curve should have a higher rate of decend in the first two seconds and a little less rate of decend thereafter. The altitude curve obtained in Run 22 of Boeing simulator shows similar features as incorporated in the Charts C and D and shown as dotted line. The rate of decend during the first two seconds is about 5100 feet per minute and thereafter reduced to about 4800 feet per minute and the average, as notice earlier, works out to be 4980 feet per minute. For this purpose the average rate of decend of 7500 feet per minute given by the Boeing is not being accepted as the same was worked out on the basis of simulated data as opposed to UFDR data.

The pitch and the bank altitudes in a stalled condition of the aircraft also suggest that the aircraft must have been falling freely under gravity. It would be like a stone falling. If a stone

falls under gravity from a height of 498 feet, it would take about 5.6 seconds and its average rate of decend would be about 5336 feet per minute. The free fall of stone assumes that a stone is falling in vaccum i.e. without air. The presence of air would slightly increase the timings. The fall of the aircraft in the last few seconds, therefore, can be compared with a free fall. Having regard to all these facts and, in particular, the fact of left bank of more than 90 degrees with nose down and side slip, it is not possible to accept that the aircraft after time frame 2926 was gaining height. In this view the altitude reading after time frame 2926, as given in UFDR data, deserves to be ignored.

In the first 5 touch and go exercises there is no abnormality. The aircraft had gone to Bangalore and flew back from Bangalore to Delhi and the CVR does not suggest of any problem. Now let us consider why certain calls other than normal and routine calls, as reflected in CVR, were made and what we can derive therefrom.

The first call out after touch down and before Rotate call is "Ke gal ae yaar chal straight runway seeda lagana' on UTC time 09:22:58. These call outs are by Capt.Khurana. The reasons for these call outs are not far to seek. Before touch down time 09:19:29

till touch down at time frame 09:22:55, it appears that the flight has been very unsteady as is evident from the following:-

1) Late on the final turn to capture localiser.

2) Unsteady in height keeping.

3) Unsteady on localiser and glide slope.

4) Trimming poor.

5) Flaps 30-40 units at the high speed of 170 knots.

6) Speed going below Bug speed.

The call 'Ke gal ae yaar, chal straight, runway seeda lagana' can be on account of aforesaid factors coupled with the fact that the landing was not straight on the centre of the runway, though it may be, within the permissible limits.

The next call out after rotate call is 'Nothing is happening' followed by the call 'let us see what to do now'. It seems that Capt. Khurana had something in his mind when these calls were made. The drop in the EPR of Engine No.1 immediately after these calls throws considerable light as to the state of mind of Capt. Khurana at that time. When aforesaid calls are evaluated with the drop in EPR of left Engine, it would appear that probably Capt. Khurana, at that time, was

thinking of giving single engine failure simulation. The static value of EPR of left Engine after the call 'Gear up' for about 4 seconds only shows that for putting the gear up, Capt.Khurana lifted his hand from throttle lever to the landing gear lever to move it to 'up position' and thereafter again started retarding the throttle. These calls cannot be attributed as suggested by Mr.Mahajan to something being wrong with the aircraft. Had it been so it would have been clearly spelt out in CVR. Further, if Capt.Khurana had found something amiss in the aircraft, he would not have, looking to his long flying experience, thought of giving emergency exercise to Capt.Vidul Mahajan.

The horn sound was recorded around 30.5 seconds from the touch down. It is evident that the trainee pilot had not used the rudder. The horn sound was on account of unsafe landing configration when Flap position was 15 and the gear was not down and one throttle had been retarded. Immediately after the horn sound, within 3 seconds Capt.Khurana shouts "Rudder, Rudder, Rudder". He does not tell the trainee pilot to apply which rudder. The aircraft was already rolling to the left gradually and after the call 'Na, Na, Leave, Leave', the rate of roll had increased sharply as noticed above. The maximum roll was about 100 degrees. In this state of affairs it appears that the trainee pilot instead of applying the right rudder,

applied the left rudder with the result that the rate of roll sharply increased inviting the call from Khurana 'Na, Na, Leave, Leave' between time frame 2924 and 2925 and stick shaker warning at time frame 2928. The roll showed an improvement and was reduced to about 60 degrees on frame No. 2930. This shows that an attempt was made to recover the aircraft but on account of the height, abnormal altitude of the aircraft, and rate of decend, the recovery was not possible and ultimately the unfrotunate crash took place.

The slight increase in the EPR of Engine No.1 towards the end only indicates that with a view to avoid crash throttle may have been moved forward about 2 to 3 seconds earlier.

Now let us consider the effect of absence of certain calls in CVR at the relevant phase of the flight. Assuming, the drop in EPR value of Engine No.1 was on account of Fuel starvation and not on account of throttle retardation, then it is inconceivable that Capt.Khurana would not notice the fall in EPR value and its effects. He would have, in that eventuality, immediately noticed the yaw and the left bank when the EPR started falling in the first four seconds. The natural reaction of Capt.Khurana would be to immediately react and utter words to the effect which would show

the failure of the engine on account of some defect in the functioning of the Fuel Control Unit or any other part of the aircraft. In that event Capt.Khurana would have immediately taken control and would not have left it to the trainee pilot. It is not possible to accept that till horn sound which was at Frame No.2919 i.e. after about 11 seconds after the EPR of Engine No.1 started dropping, Capt.Khurana would not notice the failure of the engine. Further, assuming that Capt.Khurana noticed only on the horn sound that on account of defect of some part of the aircraft, EPR of Engine No.1 is dropping and that engine had failed, he would have immediately taken control and it would have been reflected in calls recorded on CVR. Capt.Khurana would not have left it to the trainee to take the corrective measures. All these factors show that it was not a case of engine failure or defect of any part or fuel starvation but, knowingly and consciously, Capt.Khurana gave single engine failure simulation to trainee pilot Vidul Mahajan who did not apply the correct techniques to control the aircraft and rather, in panic or out of confusion, applied wrong rudder aggravating the situation and the aircraft was placed in such position that it was not possible to avoid the crash.

The Run No.13 of Ex.4 which shows the flying exercise on Engineering simulator of Boeing, matches

very closely to the parameters of the accident in question. As noticed above, the aircraft attained the maximum height of 498 feet above ground level. There cannot be any dispute about this fact. Apart from the exercises reflected in Ex.4, the exercises carried out on simulators at British Calidonian as also at Indian Airlines facilities at Hyderabad, with their instructor on the controls, show that the application of the wrong rudder is fatal at the height of 500 feet above ground level with the given roll and pitch angle. These exercise have shown that recovery in such situation is not possible. With given parameters of roll angle and pitch value, these exercises have shown, that recovery on engine failure at the height of even about 1000 feet above ground level, on the application of the wrong rudder, is mostly not possible. The application of the left rudder by the trainee pilot was,therefore, fatal.

The next aspect to be considered is whether, in the given facts and circumstances, it was advisable to give single engine failure exercise. For this purpose, let us see the experience of training pilots.

EXPERIENCE AND TRAINING OF THREE TRAINEE PILOTS.

As to what training the three training pilots had in simulator before going to actual aircraft for

training, could have been appropriately examined on perusal of their training record on simulator training at British Calidonian, UK. The said record has,however, not come forth. The record is said to have been burnt in the accident. Though three copies of the training record are prepared but all these copies are stated to have been contained in one booklet and the said booklets, it has come in evidence, were with the concerned trainee pilots at the time of the crash. One copy of the training record was meant for the trainee pilot; one for the airline operator and another for the regulatory body. None has been made available. In absence of that record necessarily this court had to fall back upon the record of training kept in unofficial diary maintained by Capt.Rao who had imparted simulator training to these trainees as instructor in British Caledonian. The record from British Calidonian could not be obtained since it was stated that only simulators were hired and the Calidonian was not concerned with what training was imparted and had not maintained any record.

As per personal diary of Capt.Rao the performance of trainee pilots specially on single engine was not upto the mark, the rudder trimming was poor and they use to forget stab trim and get panicky. Capt.Rao has said that the trainees had lot of problems on rudder trimming when he introduced them to single

engine exercise. Capt.Rao has tried to explain that after vigorous training, they learnt procedure and art of trimming on the rudder and they were found satisfactory with their existing experience and were released for the check. The cockpit procedure training was not given to the trainees since it was said to be expensive and was also not required as the trainees were holding Commercial Pilot Licence with instrument rating. Here I may mention one related aspect and that is about Mr.Rao's rating as instructor. Capt.Rao had been permitted by DGCA to act as an instructor on simulator. That was,however, subject to Capt.Rao going through training and as mentioned in the letter of DGCA dated 9th December 1993 (Ex.23), after going through the refresher course. Mr.Rao states that he underwent simulator training, as stipulated in Ex.23, under an approved instructor on 14th December 1993 and on the same date the release check by DGCA approved examiner was also conducted on him. This release check of Capt.Rao by an approved instructor was after he had imparted training to trainee pilot Mr.P.Singh on 14th December 1993. Capt.Rao states that since he had not finished his own training and check on simulator, he was unwilling to undertake training of Mr.Singh but as Slot was already allotted to Delhi Flying Club, Mr.Singh would have lost the slot as well as the money, he carried, the general first session for the pilots

with his past experience as instructor. Capt.Rao says that he had expressed his unwillingness to the boys but upon their insistence, he decided to commence the training. Capt.P.Singh and Capt.Tripathi were the first batch of trainee pilots under instructions of Capt.Rao after he left Indian Airlines which was about two years earlier. Undoubtedly the training on Simulator is very expensive. Capt.Rao states that in view of huge expense, the earlier the training finishes it is better for the trainee pilots since each trainee pilot has not only to make payment of about Rs.3 lakhs to the British Calidonian but has also to make some payment to the instructor. In this case Capt.Rao who is said to have taken the job of acting as instructor on simulator on honorary basis. As per Capt.Rao he was not maintaining any personal log book except making entries in the personal diary as noticed hereinbefore. One can understand the huge expense involved in training which has to be borne by the young trainee pilots, but keeping in view the highest standard of safety measures which are necessary in these matters, too much importance to the expense part is not justified. On this aspect I will only say this and leave it at that without saying anything more.

The training etc undergone by the three pilots before going in for their simulator training at British Calidonian has already been set out in the earlier part of this report. Even the contents of the personal diary kept by Capt.Rao show that the performance of the trainee pilots was not of a very high standard. But for the unfortunate crash during which all the three trainee pilots lost their lives, they would have after completion of the said flight, gone for test flights with a DGCA approved examiner and on satisfactory performance in the said check (C' 40A Check) their papers would have been sent for endorsement to DGCA for their acting as co-pilot on Boeing aircraft. On obtaining necessary endorsement, they could have been eligible to be released as co-pilots. Let us see the training imparted before one is released to act as co-pilot by Indian Airlines. The training imparted for type endorsement on Boeing 737 (abinitio) for release of an officer as co-pilot, in terms of Para 3.1.1 of Indian Airlines Central Training Establishment, Guidelines on Training and Licensing Procedure requires the following training:-

"3.1.1 **TYPE ENDORSEMENT ON B 737(ABINITIO)**

(Arrives C.T.E.as Trainee Pilot with CPL - Flying experience 250 to 300 hours invariably on Single En-

gine).

a) Basic Technical/Performance - 2 weeks

b) B 737 Technical Endorsement - 6 weeks

(Including Specific Performance)

c) B 737 Examination

(Technical & Performance conducted by DGCA)

d) Supernumerary Flying (Minimum 40 hours)

e) Training in Navigation Subjects - 6 weeks

	*P F	# P N F
f) Simulator Training	20 : 00	20: 00 hrs
g) Progress Check	01:30	01:30 hrs
h) Simulator Training (Endorsement)	20:00	20:00 hrs
i) Simulator Check with DGCA approved Examiner	01: 30	
j) Supernumerary Flying (Minimu 40 hours)		

* P F - Pilot Flying

P N F - Pilot-not-flying

k) Circuits/Landings on B 737 Simulator prior to commencement of flying training or interspersed with flying training	06:00	06:00 hrs

	P F	Observer
l) Flying Training on aircraft	10:00	10:00 hrs
m) CA40A Day & Night Checks/IR-LR Checks with DGCA approved	02:00	

'Examiner

n) Supernumerary Flying (Minimum 40 hours)

o) Obtains Type Endorsement Rating and IR Issue/Renewal from D G C A

p) Release as Second Officer - 3 Satisfactory Route Check with an Examiner. After release as First Officer he/she is posted to one of the four Regions depending on operational requirements.

r) Undergoes Supernumerary Flying as First Officer on all the routes of the Region. LOFT - Minimum 15 flights or 50 hours whichever is more with one Check Pilot/ Instructor as far as possible. During LOFT as many non-precision approaches as possible are to be carried out subject to a minimum of Five."

The aforesaid guidelines show that before a trainee is subjected to CA-40A check, he has to have after simulator training, flying training on aircraft for 10 hours as pilot flying and 10 hours as Observer. In the present case, the trainees were on the very first day, put on aircraft, with an instructor who had not himself imparted simulator training to the trainees, and then a single engine failure exercise was given and that too when the performance of trainees on simulator was not of very high standard. The giving of such exercise was certainly not advisable and a prudent act. But for this exercise, the crash was avoidable. Capt.Tripathi says that by way of abundant caution he had briefed Capt.Khurana not to undertake any emergency exercises in the training flight. How much can Capt.Tripathi be relied upon on this particular aspect

is another matter which would be dealt with at its appropriate stage in later part of this report but his statement that if Capt.Khurana was planning to do single engine failure, it should have been done on the down wind so that in case of an error the same could have been safely rectified, deserves due weightage, not only because the statement is coming from a highly experienced person but also for the reason that this seems to be even otherwise generally accepted position which emerges from opinion of most of the pilots, and there is hardly any contrary opinion. Capt.Tripathi also says that looking at the level of the experience of the trainee, Capt.Khurana should have guarded the control lest it is interfered with inadvertently by the trainee pilot. There cannot be any doubt that while giving single engine failure, on the given facts, Capt.Khurana should have blocked the rudder control so that the trainee pilot does not apply the wrong rudder.

I,therefore, conclude that, in the present case, in the first instance, the single engine failure exercise should not have been given. In any case, it should have been given on down wind in normal circuit. Further, even when it was given on take off, at the altitude at which it was given, Capt.Khurana should have blocked the rudder so as to rule out the possibility of application of wrong rudder by the trainee.

REGULATORY AND CONTROL FUNCTIONS OF DGCA, NAA AND IAAI

The modern aircraft systems and operating procedures are generally failure tolerent and exhibit sufficient redundency and safeguards to cope adequately with engine failure-be it human or mechanical. The greater risk is the organisational failure. The serious incident or accident is more often than not a symptom of the failure somewhere in the system. The failures may take place by mistake- indeed most hazardous errors will involve the violation of some operational rule or instructions. But violations can also be deliberate and in this case the reason can surely be found in the corporate management- commercial pressures on flight crew and lack of care and supervision being obvious motivator(See paper presented by Hong Kong in the Conference of Directors General of Civil Aviation, Asia and Pacific Region held at Pinang, Malaysia from 8th to 14th September 1994).

As stated earlier, the aspects including that of failure of management and regulatory body would be examined and dealt with under this head. I would first examine and deal with the matter of grant of approval for Capt.Khurana to act as instructor and the role of Sahara and DGCA in this respect.

APPROVAL OF KHURANA AS INSTRUCTOR

Capt.P.Khurana was said to have been granted approval to act as instructor vide letter of DGCA dated 8th March 1994. The original letter dated 8th March 1994 alleged to have been sent by DGCA to Sahara has not seen the light of the day. The evidence of Witness No.2 Capt.V.N.Arora in this regard is contradictory and unconvincing. The DGCA has also not been able to explain and clarify as to when that letter was in fact despatched by their office to Sahara. In any case, it is clear and rather admitted that the said letter did not leave office of DGCA before crash.

The approval of DGCA was sought for Capt.Khurana as an instructor vide letter of Sahara dated 28th February 1994(Ex.8). This letter was sent by Capt.Arora. Capt.Arora states that he had telephonic conversation with Mr.J.K.Sardana, Director of Training and Licensing in the office of DGCA on 7th March 1994 and Mr.Sardana told him that approval for Mr.Khurana to act as an instructor is being granted and he can go ahead with the training flight. Capt.Khurana joined the services of Sahara on 3rd November 1993. Before that he was in employment with M/s.Modiluft. Capt.Khurana was not cleared as an instructor when he left Modiluft. Sahara had not conducted any test and

training for Capt.Khurana as an instructor. Capt.Khurana was approved as Check Pilot vide letter of DGCA dated 24th December 1993 and was cleared to perform the duties of check pilots vide DGCA's letter dated 18th January 1994. He had not been cleared as check pilot prior to 18th January 1994 in any other Airlines. Capt.Arora states that experience of Capt.Khurana as check pilot can be counted only from 18th January 1994. Capt.Arora also agrees that Capt.Khurana did not fulfill condition of sub clause (iv) of Clause 2.2 of Ex.9, namely, Criteria for Approval of Examiners/Instructors/Check Pilots for Airline Operations on fixed wing Aircraft. He admitted that Capt.Khurana neither had the experience of one year as approved check pilot on the type nor the experience of 50 hours as approved instructor on another type of aircraft. Admittedly, it was in the knowledge of Capt.Arora that Capt. Khurana did not fulfill the conditions necessary when he sent letter dated 28th February 1994 seeking approval for Capt.Khurana to act as an instructor. Inspite of this knowledge Capt.Arora stated in his letter that Capt.Khurana had completed all the formalities. Since the letter dated 28th February 1994 was written knowing that Capt.Khurana was not eligible to act as an instructor a pointed question was asked to Capt.Arora that, did he write that letter on his own account or he wrote it because his employer wanted him to write such a letter. The demeanour of

the witness while answering this question deserves to be noticed. Capt.Arora after taking considerable time in answering this question and even thereafter, with lot of hesitation, took the burden of writing the letter onto himself and absolved his employer. Capt.Arora is still in the employment of Sahara. The reasons for his aforesaid answer are not far to seek. Capt.Arora said that although he knew that Capt.Khurana lacked the experience as per criteria but he wrote the said letter and stated in that letter that Capt.Khurana had completed all the formalities since there was a requirement of atleast one instructor for Sahara and the Airline had no instructor. When asked as to whether he had reported about what he had stated in letter dated 28th February 1994 to his senior executive in the company, namely, Mr.Uttam Kumar Bose, firstly with hesitation Capt.Arora stated that he had reported that to Mr.Bose but again changed stating that he had not reported it to Mr.Bose and it was purely his own decision.

AIC 13/93(Ex.9) sets out the following requirement of flying experience for grant of approval of Pilot as instructor in Clause 2.2. It reads:

INSTRUCTOR

i) Total Flying experience : 3500 hours

ii)Total command experience : 1500 hours

iii)Total command experience on

type. : 1000 hours

iv) Experience as approved

Check pilot on the type : One year

OR

Experience as approved

instructor on another

type of aircraft. : 50 hours.

Capt.Khurana though was approved as check pilot for the first time on 7th April 1992 while he was working in Indian Airlines, he did not undergo training or test with Indian Airlines as Check pilot after approval dated 7th April 1992. He proceeded on leave from 16th May 1992 to 6th June 1992 and was available after 6th June 1992 and was subsequently taken up for Aircraft A 320 Course on 8th June 1992 and discontinued it on 7th July 1992. Capt.Khurana left the services of Indian Airlines thereafter and admittedly he was neither appointed/released nor acted as check pilot prior to 18th January, 1994. He was also not appointed as check pilot while working with Modiluft. For the first time he was appointed as a check pilot was after grant of approval by DGCA vide its letter dated 24th December 1993. Capt.Khurana was released by Sahara as a check pilot on issue of letter dated 18th January 1994 by DGCA as referred to above. As already noticed

Capt.Khurana, according to Capt.Arora did not fulfill the aforesaid condition of experience of one year as check pilot witness No.5 Mr.J.K.Sardana who is the Director of Training and Licensing in DGCA, says that Capt.Khurana fulfilled condition No.4 of clause 2.2 of Ex.9 and had experience as an approved check pilot of one year. This he says because Capt.Khurana was approved as check pilot for the first time on 7th April 1992 while he was in Indian Airlines. According to the testimony of Mr.Sardana, the period of one year would start from 7th April 1992. Mr.Sardana also states that in case of grant of approval to Capt.Khurana to act as an instructor, power of relaxation was not exercised. According to Mr.Sardana the experience of one year after approval as check pilot is sufficient even though the concerned pilot may not have acted as check pilot at all. Mr.Sardana further states that period of one year could be counted even if a pilot is not eligible to act as a check pilot. Capt.Arora has not talked about relaxation. The letter dated 28th February 1994 also does not state that approval in case of Capt.Khurana was sought in relaxation of rules with regard to experience as check pilot. Capt. Tripathi also admits that he was aware that Capt.Khurana's experience as a route check pilot was not of one year and as such he was not fulfilling the reqirement of 2.2(4) of Ex.9. Capt.Tripathi,however, says that

Department of Civil Aviation can waive this condition. Except for Capt.Tripathi no one has talked about waiver or relaxation of condition regarding experience of one year as check pilot. It has also come on record that upto 28th February 1994 when the letter seeking approval was sent, Capt.Khurana had conducted only two checks though the DGCA was informed that he had conducted 6 checks. Later, after the accident Sahara said that he had conducted 4 checks. Even out of these four checks, admittedly two checks were conductred after 28th February 1994. DGCA could not be aware about these two checks when it granted approval on file on 4th March 1994. One check was on 4th March 1994 and another on 5th March 1994. After his release as check pilot the only two checks conducted by Capt.Khurana before sending letter dated 28th February 1994 were two, namely, on 25th January 1994 i.e. of Capt.S.C.Tripathi, and on 28th January 1994 of Capt.A.K.Chadha. It is strange that Sahara informed DGCA that Capt.Khurana had conducted six checks. The DGCA should have also cross checked.

According to Mr.Sardana it is immaterial whether during the period of one year, the check pilot exercises the privileges of Check pilot or not and on the same analogy it would also be immaterial if after grant of approval for one year or for a substantial part thereof the pilot remains sick or does not fly at

all for any other reason and still as per the understanding of the Department, he would fulfill the condition of one year experience of check pilot as contemplated by clause 2.2(4) of Ex.9. This understanding of Mr.Sardana and of the Department, to say the least, is absolutely against not only the plain language of the clause requiring experience but is also against the object and purpose of the clause. In the hierarchy of fliers the position of instructor is very vital and important. The instructor has to teach flying. I suppose with a purpose it must have been stipulated that a check pilot with experience as check pilot of one year, would be eligible to be considered for grant of approval as instructor. It implies that one has to exercise privileges of a check pilot before being considered for approval as instructor. According to the understanding of the Department as disclosed by Mr.Sardana a pilot would be said to be fulfilling Clause 2.2(4) after approval of DGCA even though he is not released/appointed as check pilot by the Airline and even though he is not flying at all for one reason or the other. Such an understanding did not even find favour with the fliers as is evident from the testimony of Capt.Arora and Capt.Tripathi.

During the pendency of these proceedings by issue of AIC dated 5th December 1994 requirement of

clause 2.2 has been changed in regard to the experience as check pilot. The existing clause of experience of one year as check pilot has been withdrawn and in its place the requirement of 10 checks has been provided for. The AIC now issued does not now stipulate any experience as check pilot before one can be considered for approval as instructor. This has its own fallouts. It is appropriate that now it has been provided that a check pilot should have conducted 10 checks before he is considered eligible for approval as instructor. In view of the fact that in a given circumstance, 10 checks can be completed in short span of even 2-3 days, it may not be proper to completely do away with experience. It would be desirable to combine both the period of experience and requisite number of checks. Keeping in view the safety required in aviation matters doing away with one year experience does not appear to be appropriate.

There is also another aspect of approval of Capt.Khurana as instructor. Admittedly, Capt.Khurana did not receive any training for instructorship with Sahara. It was all done with Modiluft. Regarding period of one year experience of check pilot of Mr.Khurana, Mr.Sardana says that:-

> "It is true that any approval as examiner / instructor / check pilot is valid only till such time the officer remains with the

sponsoring operator. It is correct that approval granted to Capt.Khurana to act as check pilot on 7th April, 1992 ceased to be valid after he left the said airlines. Capt.Khurana was not approved check pilot while working with East West Airlines. It would be correct to state that experience of Capt.Khurana as a flier, while he was in employment with East WestAirlines, would not be counted as check pilot, since he was not a check pilot while working with the said airlines. Capt.Khurana was approved as check pilot, vide letter dated 9.9.93, while he was working with Modiluft. Counting the period after 7th April, 1992 till Capt.Khurana left the employment with Indian Airlines and adding to it his experience as a flier after 9th September, 1993 till 8th March, 1994, would not make upto one year experience as check pilot."

The training of Modiluft requires the line-student training under supervision before the release of an officer as an instructor. Mr.Sardana admits that on the file there is nothing to show that prior to approval dated 8th March 1994 Capt.Khurana had done line-student training under supervision but says that Khurana had orally told him about it. Mr.Sardana says:-.lsl

> "On the file there is nothing to show that prior to approval dated 8th March 1994 Capt.Khurana had done line student training under supervision. Mr.Khurana had, however,orally told me about it."

I fail to understand how approval could be accorded by DGCA on the basis of what Khurana told Mr.Sardana orally and the same not having been placed on record. Mr.Sardana also says that when DGCA granted approval to Capt.Khurana to act as instructor, the department did not know as to what was the syllabus for necessary

training and satisfactory tests of Sahara.

Further, Witness No.9 Capt.P.Kling who is a Senior Vice-President(Operations) in Modiluft has explained that in their Airline before an instructor is permitted to exercise the privileges as instructor, he is required to undergo line-student training under supervision. In line-suden training Crew Resource Management/Crew Coordination Concept as Check Captain is requireed to be done. The number of such line-student training checks varies depending upon the performance of the concerned pilot. On an average trainee instructor is required to undergo 10 such checks. Capt.Khurana had not undergone line-student training checks under supervision and had he been in employment of Modiluft he would not have been released as instructor without the completion of the said checks.

Capt.Khurana was cleared to perform the duties as Check Pilot for Boeing 737-200 Aircraft for Sahara by Witness No.10 Capt.Vinod Mahajan who is an Inspector of Flying with DGCA. Mr.Sardana has stated that such a clearance was not necessary. The clearance was given under the signatures of Capt.Mahajan vide letter dated 18th January 1994 of DGCA. Capt.Mahajan states that neither this letter was necessary nor was he authorised to write that letter on behalf of the DGCA. If that is so, it remains unexplained, as to why letter dated 18th January 1994 was issued by Capt.Mahajan on behalf of

DGCA.

Further according to Mr.Sardana the necessary training and satisfactory test under clause 1.6 in regard to an instructor can either be before grant of approval of DGCA or after grant of such approval. In case the necessary training and satisfactory tests are conducted after such approval, according to the understanding of Mr.Sardana, it is not necessary for the Operator to report to the DGCA that the concerned officer had completed the necessary training and passed the tests satisfactorily. These matters have been left to the good sense of the operator to comply with. It is not a happy state of affairs. The regulatory body should ensure that the concerned officer has undergone the necessary training and pass the tests satisfactorily. The regulatory body should also lay down minimum training requirement which factor is absent in the AIC 13 of 1993. AIC 13 of 1993 has since been amended on 5th December 1994 now stipulating that the pilot has to undergo necessary training and pass the tests satisfactorily before approval of DGCA for a pilot to act as an instructor is sought. This is a welcome change in the AIC but more is required to be done by providing minimum training programme.

Mr.Sardana is not a pilot. He is not associated with flying. He is a Telecommunication Engineer.

Mr.Sardana states that as a matter of normal routine when papers are submitted for seeking approval of pilot either as a check pilot or instructor or examiner to DGCA, normally the same are not required to be checked/scrutinised by any pilot. The same is the case of endorsement as co-pilot. Keeping in view that flying is a specialised subject/art, it is necessary that ordinarily a person with good flying experience and background should be associated in the grant of such approvals.

In letter dated 8th February 1994 addressed to Indian Airlines it was stated that newly inducted instructor had to be checked by DGCA Flight Inspector before they are assigned to impart instructions. Mr.Sardana states that it was erroneously stated but that letter was not withdrawn because regulations are a dynamic process and Department keeps on adding or deleting from it from time to time and Department may be contemplating a similar procedure and that is why letter dated 8th February 1994 was not withdrawn.

I may state that in India till the recent changeover primarily there were only two Airlines, namely, Indian Airlines and Air India. Both are government controlled organisations. With the recent change and 'open skies' policy various private operators have come into the field. In view of the changed

condition, the responsibility on the shoulders of DGCA is greater. Mr.Sardana states that the Operators are not required to obtain approval of DGCA for their Training Manual. It is only required to be submitted to DGCA. I am informed that during the pendency of these proceedings necessary circular requiring approval of DGCA for Training Manual has been issued. It is required to be noticed that though DGCA granted approval on 4th March/8th March 1994 it did not know as to what was the syllabus for necessary training and satisfactory test of Sahara for their instructor. It was not a happy state of affair but nothing more is required to be said now since after the accident Sahara submitted their Training Manual sometime in May 1994 which has since been approved.

Capt.Khurana had moved on from one Airlines to another in last two years. After leaving Indian Airlines in 1992, he joined East West Airlines; then left East West Airlines and joined Modiluft and finally Sahara on 3rd November 1993. Though DGCA had granted approval for Capt. Khurana to act as a Check pilot in Indian Airlines but before he could be given necessary training and perform the functions of Check Pilot, he left the services of the said Airlines. Admittedly, Capt.Khurana did not act as a check pilot either in Indian Airlines or in East West or in Modiluft. He was

released as a check pilot for the first time by Sahara on 18th January 1994. Admittedly, according to Sahara, Capt.Khurana did not fulfill the condition of Clause 2.2(iv) of one year experience as check pilot necessary for grant of approval to act as instructor. Capt.Khurana in terms of the criteria applicable was not eligible for grant of approval as Instructor.

CONDUCT OF SAHARA

As stated earlier, now there is greater responsibility on the shoulders of DGCA. At the same time there is also great responsibility on the operators. The conduct of Sahara throughout shows that they have not acted with responsibility. The facts which have come to light in these proceedings show that the conduct of Sahara has been deplorable before the crash in the matter of planning training flight in question and seeking approval of DGCA for Mr.Khurana as instructor. It has also been deplorable immediately after crash and also during the course of these proceedings.

Sahara should have thoroughly scrutinised the training papers of the trainee pilots and preserved the record before planning the trainee flight. All the three copies of record of simulator training at British Calidonian should not have been handed over to the concerned trainees. This action has deprived this

court the advantage of the perusal of the said record.

In so far as Sahara is concerned as it evident from the testimony of both Capt.Arora and Capt.Tripathi, Capt.Khurana was not eligible for approval as instructor since he lacked experience of one year as a check pilot. Therefore, Sahara had no justification whatsoever to state that Capt.Khurana fulfilled all the conditions when admittedly it was not so. It is not very material whether Capt.Arora wrote that Capt.Khurana fulfilled all the conditions on his own in his letter dated 28th February 1994 or on the asking of his employer. Assuming that he wrote on his own then too Sahara cannot be absolved of the responsibility since Capt.Arora was their agent and representative. It is,however, difficult to comprehend and believe that Capt.Arora wrote that letter on his own. Probably Capt.Arora has taken the burden on himself with a view to save the embarrasement to his higher ups and the employer. The DGCA may have power of relaxation but it was nobody's case that approval of Capt.Khurana as instructor was sought in exercise of the said power of relaxation. The power of relaxation is also not a blanket power. In case one seeks the exercise of power of relaxation it is to be stated that in what respect and for which parameters relaxation is being sought. The regulatory body has also to place on record the

reasons showing application of mind for grant of such relaxation. Mr.Sardana has deposed that Capt.Khurana was not granted approval in relaxation of any requirement.

Further, Capt.Khurana had not undertaken any training or test necessary for performing the privileges of instructor while he was with Sahara. He is stated to have given certain documents about such training when he was in Modiluft. Sahara should have checked up with M/s.Modiluft whether Capt.Khurana had undertaken full training as per the requirement of their Airlines for exercising the privileges of instructor instead of straightaway relying upon what was stated by Capt.Khurana.

Another aspect that deserves to be noticed is a note at the bottom of office note dated 7th March, 1994 to the effect that "confirmed by DTL telephonically that Capt.P.Khurana is cleared B 737-200 as instructor, letter will follow." This note is in the hand of one Mr.G.K.Luthra and has been initialled by Capt.Arora. It is nobody's case that Mr.Luthra had any talk with Mr.Sardana. Why this note was necessary to be appended on Annexure 6 is something which could not be explained by Sahara. It is a curious note. There was no occasion for Mr.Luthra to make that note. There was no occasion for Capt.Arora to initial that note.

It seems that it was made after the crash. Who could be interested in creating such a evidence except the employer.

Even after the accident and also during the course of the inquiry the conduct of the Airlines has not been straight forward. It is evident that Sahara made up its mind that it was a case of simulated engine failure as early as on 9th March 1994 when an insertion in newspaper Ex.15 was given justifying that such an exercise was necessary. The point is not whether such an exercise was necessary or not. For the present, the point is, that having taken that position Sahara should have been straight forward in its stand. Instead of doing that, they took absolute converse stand in these proceedings to the effect that Capt.Khurana was briefed by Capt.Tripathi in the presence of Capt.Arora that no emergency exercise should be given during the course of the training flight. This stand assumes such an exercise was not necessary. To justify that stand further and having been confronted with Ex.15, Sahara came forward with escape route in the form of evidence of witness Mr.A.K.Ohri. His testimony is utterly unconvincing and not at all reliable. It is inconceiveable that Ex.15 would have been given without consulting Officers like Capt. Arora and Capt. Tripathi and other senior officers and in fact on the instruc-

tions of such officers. In view of the totality of these circumstances it is also not conceivable that Capt.Khurana was briefed not to give any emergency exercise in the training flight.

In this case, as is apparent from aforesaid, the lack of proper corporate management seems evident when one bears in mind the manner in which the approval of DGCA for Capt.Khurana to act as instructor was sought and the manner in which the training flight was planned and executed before even receipt of formal approval from DGCA. Commercial pressure also is evident from the testimony of Capt.Arora when he says that the Airline was in the need of an instructor and that is the reason that he made application for his approval knowing well that Capt.Khurana was not eligible. It is not possible to accept though he has taken the burden on himself to believe that he did it without the knowledge, consent or at the instance of his superiors.

In the newspapers of 10th March 1994 the advertisement Ex.15 issued by Sahara was published which suggests that an engine failure exercise was given in the training flight in question with a view to give out that such type of typical, dynamic training exercises were mandatory requirement by the statutory authorities. This advertisement came to light only

when evidence was being recorded.' The advertisement was brought on record during the cross examination of Mr.S.Krishnan on 15th November 1994. Mr.Krishnan, however, stated that he could not say who gave the insertion Ex.15 in the newspaper. The witness was directed on 15th November 1994 to place on record the basis on which Ex.15 was given in the newspaper. This led to filing of affidavit dated 22nd November 1994 by Witness No.12 Mr.Ashok Kumar Ohri who is Incharge for all media releases on behalf of the Company. He is not an expert in flying. In fact, he does not know anything about flying and also much about the requirement of DGCA. He has taken upon himself the entire burden of issue of Ex.15. This document,inter-alia, gives an impression that power of one engine had been reduced to zero in the ill-fated flight and Sahara knew about it on 8th March, 1994 and also that such an exercise was necessary. When asked as to how he reached the said conclusion, an utterly unconvincing and unsatisfactory reply was given that when he had gone to Airport on 8th March 1994, he overheard certain people saying that the power of one engine had been reduced to zero and that is how he stated about reduction of power in the Press release and he did not discuss about it with either Capt.Arora or Capt.Tripathi or any other person in Sahara about the reduction of power of one of the engines. He is said to have been scolded by Mr.Uttam

Kumar Bose orally for release of Ex.J3. He did not remember the name of a single person whom he may have overheard talking about reduction of the power. It is inconceivable that in an insertion in the newspaper about the power of one engine having been reduced to zero would be given without the knowledge of the Senior Pilots and the senior executives working in Sahara. I wish that advertisement being a vital document would have been collected by Inspector of Accidents and placed on record and mentioned in his report instead of the same being brought on record by Mr.Mahajan appearing for Mrs.Khurana. Be that as it may, this insertion shows that Sahara had made up the mind soon after the accident that it was a case of simulation of engine failure by the instructor and that it was necessary requirement of training stipulated by the statutory authorities and as such there was nothing wrong in the said exercise. If it was so the Sahara should have taken that stand. It is also a pointer to the fact that the stand of Sahara that Capt.Khurana was asked not to give emergency exercises to trainee pilots is also not correct. That being the position Sahara should not have taken the stand about the briefing of Capt.Khurana not to give emergency exercises, the stand, with which they persisted. Even otherwise that stand does not seem to be correct. At best it can be said that Capt.Tripathi may have told Capt.Khurana that if he considers necessary he can give to the trainee

pilots engine failure simulation exercise. Otherwise, it seems difficult to accept as to why, on his own, Capt.Khurana would give such a exercise contrary to his briefing, more so, when it has come on record that Capt.Khurana had earlier never violated the specific instructions given to him by his seniors. It is, however, altogether a different matter whether Capt.Khurana should have given single engine exercise to the trainee pilots or not keeping in view the experience and record of performance of trainees on simulator and other aspects which have been earlier noticed or if at all it should not have been given on take off and should have been given, in any case, on down wind in normal circuit and further, in the given position, Capt.Khurana should have anticipated that trainee may apply a wrong rudder and bearing in mind its lethal effect, he should have blocked the right rudder so that the trainee could only apply right rudder and the instructor should have also not waited for long when the trainee did not apply the rudder and should have taken over the controls.

ROLE OF DGCA

As stated earlier, with the present 'Open Skies Policy', the burden on the shoulders of the regulatory body like DGCA is greater. Prior to the present policy, primarily there were only two operators

in the field of Civil Aviation, namely, Indian Airlines and Air India, both government controlled organisations and in the very nature of things, the commercial considerations were not as dominating as may be prevelant in private operators. The compromise with the safety standards cannot be allowed because of commercial considerations. The regulatory body can, however, have no complusion whatsoever for granting such approval. In this case the understanding of DGCA of criteria 2.2(iv) regarding the eligibility conditions for approval as instructor is contrary to the plain language of the criteria. I am surprised at the understanding of the said requirement of criteria of DGCA when it takes the stand that experience of one year as check pilot is required to be taken into consideration from the date DGCA grants approval in case of a Pilot as check pilot and it is immaterial whether he performs the function of check pilot or not. Even if these functions are not performed one would still be eligible to be considered for approval as instructor after lapse of one year. When the criteria talks of experience it pre-supposes that the officer has performed the functions, during the said period of one year of a check pilot. Anything, particularly when that may jeopardise safety, cannot be left to the goodwill of the Operator only. Further, the regulatory body is required to provide light to the Operators by providing some minimum uniform standards. If the DGCA had appropriately

understood the criteria it would not have granted approval in the case of Capt.Khurana. The Indian Airlines guidelines, referred to above, lays down the following criteria for a pilot before he is released as Instructor:-

"5.2.4.2 **INSTRUCTORS**

i) Under Study Training on Simulator during PIC/Type Endorsement Training. During under Study Training, Trainee Instructor will be observing the briefing, training and de-briefing being given for the first half of the training time. He will then himself do the same during the rest of the training time under the observation of the Training Instructor/Examiner.

A certificate of suitability will be issued by the Training Instructor/Examiner after completion of the Training.

ii) To carryout Simulator Training independently of atleast one batch for Type Endorsement/PIC.

iii) One Simulator Check (R H S) with an approved Examiner.

iv) Three Route Checks (.R H S) with atleast two Examiners.

v) On satisfactory completion of the above, he is released to carryout IR/LR Renewal Checks.

vi) Under Study Training on aircraft (Presently Flying Training is done only on B 737 aircraft) before released to carryout flying training. Trainee Instructor himself will demonstrate & carryout atleast one training session on the aircraft. A certificate of suitability will be issued by the Training Instructor/Examiner after completion of the Training.

-Letter of release as Instructor."

Sahara, as stated earlier also, had no training manual. DGCA should have atleast asked Sahara as to what was their training manual so that regulatory body had an opportunity to know whether it was adequate or not. DGCA should have also cross checked the facts before grant of approval of Capt.Khurana as instructor. So much about the role of regulatory body.

FIRE FIGHTING OPERATIONS

Preliminary finding was recorded in the Report of Inspector of Accident, on the basis of Group report, that there was no mobile water replenishment arrangement for the crash fire tenders positioned for fire fighting, resulting in dislocation of CFTs from ideal position to collect water from static tank No. 9 and 11 and thus fire fighting operation was carried out in stages and also that the quality of the produced foam was not standard and the fire extinguishing media was not creating required actions on the fire and also that on two CFTs, the monitor controls were unserviceable and on the other two monitors, controls became unserviceable during fire fighting operations with the result that side channels for fire fighting were used on these crash fire tenders.

Firstly it may be noticed that no expert was involved in the Group to study and analyse whether the

fire fighting operation was adequate or not. Mr.Chandna, Inspector of Accidents, admittedly was not an Expert in fire fighting operations. Likewise, other members of the Group were also not admittedly experts in fire fighting operations.

Secondly, the statements of Assistant Director (Fire) or Fire Officer Mr.Mehary who were admittedly present at the time of fire fighting operations were not recorded.

Thirdly, the report containing the aforesaid deficiencies in fire fighting operation was submitted about four months after the accident.

Fourthly, the preliminary finding regarding the poor quality of foam was given but no investigation was carried out for checking the quality of foam and log book though makes detailed entries about other aspects, there is no mention about poor foam formation.

Fifthly, one of the crash fire tender of which the monitor was unserviceable was admittedly being used as a mobile water tank and thus the preliminary finding that there was no arrangement for water replenishment cannot be sustained.

Before concluding the fire fighting operation aspect, reference may also be made to the depositions of Witness No.11 Mr.K.M.Dhyani, Fire Officer who was Shift Incharge at the Fire Station, Palam Airport on

8th March 1994 and Mr.Gupta witness No.13. The Group report regarding fire fighting operations is primarily based upon what Mr.Dhyani had stated. From his testimony it seems that the supply of water on 8th March 1994 was also available from Waterising system. It has also been explained by witness No.13 Mr. Gupta, Deputy General Manager (Equipment & Sports) that waterising system was under installation for protection of the Terminal Building and the work was under execution and it had reached a stage where it could be activated by manual operation and when need for additional water was felt, this potential was also used. Regarding the unserviceability of monitors at crash fire tenders as stated in Fire Fighting Operation Report Ex.7, Mr.Gupta has explained that the monitor of one fire tender (AL 2) was unserviceable inasmuch as it could not be used at all and for that reason the said vehicle was used as a water tender. The monitor of crash tender AL6 was said to be serviceable on manual operations but its electronic controls were not functioning. The monitors of other fire tenders were in working condition. The witness explains that the ICAO regulations do not stipulate that monitors should be electronically operated or manually operated and further that in case it is not possible to operate monitors manually four side lines in the crash tender can fight the fire. One of the monitor which had become totally unserviceable during fire fighting operations on 8th March 1994 was

said to have been set right same day in the evening or the next day. The monitor of the fire tender which was being used as a water tender had become unserviceable about an year earlier. It took a litle over one year to set right the said monitor. The time taken for making unserviceable monitor depends upon the nature of the defect and in case any part is to be imported it takes more time. It is not desirable that unduly long time is taken in making a monitor serviceable even if some parts are to be imported. In such matters, bearing in mind the importance of fire fighting operations, clearances are required to be given expeditiously. Regarding foam formation, from the testimony of this witness, it appears that the foam formation is controlled by a component called Proportionator installed on the fire tenders and that the desired quantity is prefixed and Proportionator does not require any adjustment and there cannot be any difficulty in foam formation. According to Mr.Gupta the desired quantity of foam was being produced and it is not possible to state about the quality of the foam by observing it by naked eye.

The net result is that there was nothing wanting in fire fighting operations. Rather,. the officers and officials of all Fire Departments including IAAI deserve to be complimented for their grand efforts to control the fire and, in particular, in

saving the wings of the Aeroflot aircraft which contained 50 tonnes of fuel. Had it not been controlled and the said fuel had caught fire it would have been a bigger disaster.

WHY THE CRASH - FINDINGS & CONCLUSIONS

A:- **FINDINGS AND CONCLUSIONS ON CREW ERROR**

1. Having regard to the experience of Vidul Mahajan, engine failure exercise should not have been given.

2. Capt. Khurana should have guarded / blocked the Rudder control and given clear commands as Instructor so as to obviate the application of wrong Rudder control by the trainee pilot.

3. The crash occured due to the application of wrong rudder by trainee pilot Vidul Mahajan during engine failure exercise.

B. **OTHER FINDINGS AND CONCLUSIONS**

1. Sahara should not have planned the training flight without retaining the records of simulator training of the trainee pilots.

2. Sahara knowing that Capt.Khurana was ineligible, should not have sought approval of DGCA for his acting as instructor.

3. The DGCA should not have granted the approval for Capt. Khurana to act as instructor since he lacked the experience of Check Pilot for one year as stipulated by sub clause (iv) of Clause 2.2 of AIC 13/93.

RECOMMENDATIONS

1. Suspension of approval of Sahara India Airlines as Air Taxi Operator for a period of one month.

2. Initial flying training of raw and fresh trainees normally to be conducted by a senior and experienced instructor.

3. Three copies of record of simulator training of trainee pilot should be prepared. Before commencement of training on actual aircraft, copies of such record should be supplied to the regulatory body, trainee and the airline operator.

4. During flying training on aircraft single engine simulation should only be on down wind leg in normal circuit.

5. Minimum training programme on each type of aircraft in line with the guidelines of Indian Airlines / Air India for endorsement as First Officer, Check Pilot / Instructor / Examiner.

6. Regulatory body to ensure before granting requisite approvals that the pilot has

undergone necessary training and has passed the tests satisfactorily.

7. All operators should have training Manuals to ensure uniform and standardised training techniques. Manual, so far as possible, should provide how each exercise should be conducted and role to be played by Instructor, during such exercise(s). Manual should be approved by experts of Flight Inspection Department and Director of Training and Licencing of DGCA before an operator is allowed to operate.

8. Experience of minimum one year of working as a Check Pilot on the type of aircraft as one of the requirement for approval as Instructor on that type in addition to requirement of atleast 10 checks on type during the period of one year.

9. Alternate clause 2.2(iv) of A.I.C.No. 23/1994 providing for experience on another type of aircraft should be amended to read:

> "Experience as functional Instructor on similar type of aircraft i.e. from one Jet aircraft to another Jet aircraft or one piston engine aircraft to another piston engine aircraft."

10. Stress on Pilots having adequate proficiency before conducting Check / Instructional / Examination flight. Proficiency in conducting instructional flights needs more attention as such flights require more skill. One way of ensuring proficiency is to lay down recency requirements in same type of flying. Existing requirement for a Pilot to have 10 hours of simple line flying experience in preceeding 30 days is not relevant for conducting Check / Instructional / Examination flight.

A Pilot should be required to have a specified experience as Check-Pilot / Instructor / Examiner, as the case may be, in preceeding given time period to conduct Check / Instructional / Examination flight. A Pilot not having the required necessary experience could be subjected to specified training or test.

11. Inspite of liberalisation and tremendous growth of Aviation industry, the manpower of officers and staff in DGCA continues to be almost same. The number of licenses has increased manifold. Renewals and issues of licences of Pilots and grant of approvals and approval of training institutions etc is being handled by same staff strength, for last number of years. Manpower

needs to be enhanced and work required to be redistributed and reorganised.

Work connected with grant of pilot licences including technical and performance papers and renewal of pilot licences alongwith approvals and grant of approvals of Check Pilots / Instructors /Examiners be placed under Flight Inspection Directorate of DGCA.

Operation section should be formed under Flight Inspection Directorate of DGCA to look after approvals of simulators, and Advanced Training Institutions etc, both in India and abroad.

A senior, experienced and fully qualified instructor / Examiner on modern Jet aircraft should be incharge of training and licencing and flight crew standard section. To attract suitable candidates, salary structure and service conditions be appropriatedly altered.

12. To standardise the policy with respect to import of Aircraft by the Operators, maintenance of proper record, and the maintenance policies of various types of aircraft.

13. During investigation of air accident, alongwith Inspector of Accidents, expert(s) in the field of Flying on particular type of aircraft should be associated. Likewise experts from other fields like Fire operation and/or other experts, depending upon the circumstances of each case, should be associated.

14. Expeditious grant of clearances for import of fire fighting equipments and/or parts thereof.

15. Simulator of CTE, Hyderabad should be given on hire to trainees of other operators.

(Y.K.SABHARWAL)

JUDGE

HIGH COURT OF DELHI

NEW DELHI

22ND MARCH, 1995

We Agree

(AIR COMMODORE R.P.S.GARCHA)

ASSESSOR

(R.D.THAKUR)

ASSESSOR

ACKNOWLEDGEMENTS

I did not know much about field of Flying when I gave consent for performing the functions of Court of Inquiry. In fact, let me concede that I had no knowledge about the technical aspects of flying or other technical aspects of civil aviation. It would not have been possible to make this report but for the able assistance, guidance and help received from various persons. This report would be incomplete without my expressing gratitude to them.

Air Commodore R.P.S.Garcha, one of the Assessors is not only a senior and experienced Flier/Pilot but is also highly knowledgeable in the field of flying and hard working. Likewise, the other assessor Mr.R.D.Thakur, General Manager (Engineering) in Indian Airlines, with his deep knowledge, devotion and hard work was able to explain to me the technical engineering aspects in a simple manner so that I was able to understand these aspects without much difficulty. It has been a great pleasure to be associated with Air Commodore Garcha and Mr.Thakur.

In Mr.H.S.Khola, Director General of Civil Aviation, I found deep knowledge and understanding of various aspects of Civil Aviation. An efficient officer, who has been source of great help in the investigation. What I have stated about Mr.Khola is equally true about Mr.Satinder Singh. Mr.Satinder Singh was found to be a very hardworking and knowledgeable officer. I thank both of them for the able assistance rendered to me.

The Inspector of Accidents is the backbone of such investigations. Mr.V.K.Chandna, Inspector of Accidents provided necessary assistwith ability. My thanks to him.

Mr.J.S.Wazir acted as Secretary to the Commission. But for his help and assistance it would not have been possible to conclude the proceedings. It is unfortunate that he developed some health problem soon after the conclusion of the proceedings but inspite of that Mr.Wazir continued rendering the necessary assistance, for which I am greatful to him. I also wish him good health.

I am also thankful to various other officers/officials of DGCA who have always been ready and willing to render such help as was required and with the smiling face. In this respect special mention may be made of Mr.K.Gohain, Director of Air Safety of DGCA at Bombay.

The officers of National Transport Service Board, Washington, British Calidonian, UK, Fire Department at Heathrow Airport, London, the Fire Department at Frankfurt Airport, officers of Lufthansa Training Centre, Frankfurt, CTE, Hyderabad, Air India, Indian Airlines and NAL, Bangalore deserve to be thanked for rendering able assistance, help and guidance which has been very useful in the inquiry.

Mr.Alok Mahajan, Mr.Lalit Bhasin, Mr.R.K.Anand, Mr.R.S.Suri, Mr.Robin Mitra and Mr.N.A.K.Sarma, advocates who appeared in the proceeding rendered useful assistance for which I am thankful to them. My special thanks to Mr.Sarma who brought out in his cross examination of the witnesses certain important aspects with which N.A.A. may not have been directly concerned, but without the said aspects the report would have been incomplete in the real sense. I may also record my sincere appreciation for the services

rendered and work done by my personal staff, including Mr.V.K.Kochhar, Mr.S.K.Bansal and Mr.Sunil Koushal, without whose assistance the report could not have been made ready.

I conclude by recording my deep condolences to the members of the breaved families.

(Y.K.SABHARWAL)

JUDGE

HIGH COURT OF DELHI