Accident to Indian Airlines Boeing 737 Aircraft VT-EFL on
16th August 1991 Near Imphal, Manipur

REPORT OF THE COURT OF ENQUIRY

HON'BLE MR. JUSTICE UMESH C. BANERJEE
JUDGE, HIGH COURT, CALCUTTA

ASSESSORS

1. *Shri B.P. Baliga*
2. *Wg. Cdr. P. Ashoka*

SECRETARY

Shri A.K. Sinha

MINISTRY OF CIVIL AVIATION & TOURISM

DECISION OF GOVERNMENT OF INDIA ON REPORT OF THE COURT OF INQUIRY OF THE ACCIDENT TO INDIAN AIRLINES B-737 AIRCRAFT VT-EFL NEAR IMPHAL ON 16.8.1991.

On 16th August, 1991 an Indian Airlines Boeing-737 aircraft VT-EFL crashed near Imphal while operating a flight IC-257 from Calcutta to Imphal. The flight was under the command of Capt. Shekhar Haldar with Capt. D.B. Roy Choudhury as Co-pilot. There were 69 persons on board including 6 crew members. All occupants died in the crash.

2. Government of India appointed Shri Justice Umesh C. Banerjee of the Calcutta High Court to hold a formal investigation into the accident under Rule 75 of the Aircraft Rules, 1937. Shri B.P. Baliga, Formerly Director of Engineering, Air India and Wg. Cdr. P. Ashoka, Executive Director (Flight Operations & Safety), Hindustan Aeronautics Limited, Bangalore were appointed as assessors to the Court of Inquiry. The report of the Court of Inquiry was received by the Government on 30.4.1992.

3. The Court of Inquiry has concluded the 'Probable Cause of the Accident' as follows :

> "The accident occurred by reason of a grave error on the part of the Pilot-in-Command in not adhering to the operational flight plan and ILS let down chart and not realising that his early descent to 10,000 feet and turning right for outbound leg without reporting overhead VOR would result in loss of time reference and as such misplace him in the hilly terrain. The Pilot-in-Command's action may have been influenced by his extreme familiarity with the terrain".

The Court has ruled out sabotage and structural failure as the cause of the accident. The Court has made 40 findings and 50 recommendations.

4. The Government have accepted the report of the Court of Inquiry along with the findings and the probable cause of the accident. Comments on each finding are given at Annexure 'A'.

5. The recommendations made by the Court of Inquiry aim at enhancing the safety of aircraft operations and are generally accepted for implementation as indicated in Annexure 'B' attached.

	FINDINGS	COMMENTS
1)	The aircraft had valid Certificate of Airworthiness and was maintained in accordance with the approved maintenance schedules. The aircraft was fully airworthy prior to its departure from Calcutta and during the course of the entire flight.	Agreed.
2)	The flight crew had appropriate and valid licences to operate the flight. Both the pilots have been medically fit throughout their flying career.	Agreed.
3)	The weather at Imphal at the time of crash was - visibility 7 Kms., Clouds 3/8 800 feet, 5/8 1800 feet, 1/8 cb 3000 feet, 8/8 10,000 feet - which was above the operator's weather minima for an ILS approach at Imphal.	Agreed.
4)	The ATCO had passed to the aircraft the weather prevailing at 0630 UTC but had not passed the weather of 0700 UTC which was same as of 0630 UTC except that 1/8 cb 3,000 feet was not prevailing at 0630 UTC. The cb was however, located in the North-East direction of the airport whereas the aircraft approached form South-West direction. The upper wind at 3.1 Kms (10160 feet) estimated by India Meteorological Department at 0600 UTC was 120 /10 Knots.	Agreed.
5)	The landing and navigational aids (ILS, VOR & NDB) at Imphal Aerodrome were functioning normally on the day of the accident. Locator Beacons at ILS markers however, have not been provided. The last calibration was effected on 5th June, 1991 and was valid on the date of the accident.	Agreed.

6)	Status indicator lights of ILS were not functioning in the Control Tower on the day of the accident and had, in fact, been in such a state for quite some time past.	Agreed.
7)	DME co-located with VOR had not been installed till the day of accident even though NAA had received the equipment at Imphal in July, 1991. The DME, however, was subsequently installed and made operational on 29th November, 1991.	Agreed. It is true that the DME was received in Imphal at the end of July, 1991 and was installed and commissioned on 29th November, 1991. It takes about 3 months to install and declare a navigation system operative like the DME. Considering the rainy season at Imphal time taken for installation is reasonable.
8)	Distance Measuring Equipment (DME) is a helpful navigational aid but cannot be termed to be an essential navigational aid. Non-availability of DME at Imphal has not contributed to the accident.	Agreed.
9)	Installation of Automatic Direction Finder - AD-200 at Imphal Airport is not considered necessary on the threshold of 21st century, more so by reason of the availability of VOR which is a modern navigational and more effective pilot interpreted aid.	Agreed.
10)	At Imphal there is no equipment installed to provide Runway Visual Range information which would be of great assistance to the pilots for carrying out instrument approach and landing during unfavourable weather conditions.	Agreed. Meteorological Department would be asked to examine immediately installation of RVR at all places where ILS is installed.
11)	ATC multi-channel tape recorder supplied by Stencil Hoffman of USA was procured by National Airports Authority and received at Imphal in early 1983, but has not yet been	Agreed. It could not be commissioned for want of critical spares. Ultimately it was commissioned in Decem-

	installed even after nine years of procurement.	ber 1991 by taking spares from other similar equipments.
12)	By reason of non-availability of the ATC tape at the Control Tower at Imphal, performance monitoring of ATCOs has become an extremely difficult.	Agreed. NAA have initiated steps to procure and install such tape recorders at airports to which Indian Airlines is operating scheduled services.
13)	ATCOs are not having sufficient familiarisation flights.	DGCA has already approved 250 familiarisation flights to ATCOs per year.
14)	Air Traffic Control at Imphal Airport on the day of the accident was manned by an officer not formally rated by National Airports Authority, though the concerned ATCO had been informally authorised to handle the air traffic by a senior officer at Imphal.	Agreed. NAA has now introduced the system of ratings for all ATCOs.
15)	The Senior Aerodrome Officer being a formally rated Air Traffic Controller, was available at the aerodrome but not at the Control Tower at the time of the crash.	Agreed. However, a qualified ATCO was present in the tower and was handling all air traffic at that time.
16)	No refresher courses are arranged by National Airports Authority for their Air Traffic Controllers.	Agreed. NAA is now planning to introduce refresher courses for its ATC Officers.
17)	Licensing of Air Traffic Controllers has not yet been effected.	Steps are being taken to introduce licencing of ATCOs.
18)	Licensing of aerodromes also has not yet been effected.	Steps are being taken to introduce licencing of aerodromes.
19)	There are no maintenance schedules for ground navigation, communication and landing aids.	Agreed. NAA will be directed to have proper maintenance schedules for all its equipments.

20)	The flight crew did not adhere to the operational flight plan after coming overhead Comilla. They did not go overhead Agartala VOR and instead flew almost directly to Imphal from Comilla.	Agreed.
21)	The flight crew gave incorrect call-out to Agartala ATC that they were overhead Agartala VOR even though the aircraft was nowhere near Agartala VOR.	Agreed.
22)	The flight crew commenced descent nearly 10 minutes before the top of descent prescribed in the operational flight plan without realising that the same would result in a change of Estimated Time of Arrival.	Agreed.
23)	The flight crew requested Imphal ATC for setting course directly outbound for ILS let down, which was cleared by the ATC. This was procedurally a wrong call-out by the flight crew. Permission by the Air Traffic Controller for direct outbound could not possibly have misled the pilot not to come overhead VOR.	Agreed.
24)	The flight crew gave wrong altitude call-outs to Imphal ATC on a number of occasions during descent and let down which can only be termed as an act of indiscipline.	Agreed.
25)	The aircraft never came overhead Imphal VOR even though the ATC had asked it to report overhead.	Agreed.
26)	The flight crew reported approaching overhead VOR even though the aircraft was about 14 miles away from Imphal VOR at that point of time.	Agreed.

27)	The flight crew had initially intimated to Imphal ATC the estimated time of arrival as 07:16 hours UTC. However, after setting course directly to Imphal from Comilla they revised their ETA to 07:12 hours UTC.	Agreed.
28)	The possibility of the flight crew being misled by reason of false indication of the VOR is ruled out.	Agreed.
29)	The flight crew by virtue of not reporting overhead VOR and turning right much shorter of the same, instead of turning left overhead VOR for tear drop entry, lost the time reference required for carrying out ILS let down.	Agreed.
30)	Till the time of impact the aircraft was not on localizer or glide path.	Agreed.
31)	There was total lack of discipline and professionalism during the flight on the part of the flight crew by not adhering to the operational flight plan as also the ILS let down chart together with wrong position reports and altitude call-outs.	Agreed.
32)	The Pilot-in-Command did not adhere to the ILS let down chart but instead seems to have relied upon the ground features with which he thought he was extremely familiar.	Agreed.
33)	The flight crew committed a grave error of not realising that early commencement of descent to 10,000 feet and turn to right without coming overhead VOR would misplace them in the hilly terrain further away from the airport.	Agreed.
34)	No emergency condition was communicated by the flight crew during the entire course of flight till the time of impact.	Agreed.

35)	The co-pilot throughout the flight remained as a mere passive and mute spectator to the deviations from the prescribed operational procedures.	Agreed.
36)	Tail wind of even 60 knots during outbound leg could not have drifted the aircraft to the place where the crash has taken place if the ILS let down procedure was adhered to.	Agreed.
37)	About six seconds prior to the impact, GPWS warning came 'ON', but it was not possible to clear the hill ahead even if the crew had taken immediate action to climb.	Agreed.
38)	The crash occurred on the Thangjing Hill about 300 feet below the hill peak and at a distance of 20.19 nautical miles from VOR Imphal Airport as per the distance estimate given by the Directorate of Survey (Air).	Agreed.
39)	There was no evidence to indicate any sabotage or inflight structural failure of the aircraft.	Agreed.
40)	Search and rescue operations were carried out in a manner as is expected in the circumstances as were prevalent on the date of the accident at crash site.	Agreed.

	RECOMMENDATIONS	COMMENTS
1)	The Indian Airlines should reiterate to all its pilots that they must meticulously follow all stipulated operational procedures.	Acceptable.
2)	The Flight Safety Directorate of Indian Airlines should be restructured so as to introduce a flight standardisation cell which would be responsible for surveillance checks on board the aircraft as also simulator training and monitoring of other related operational aspects. This should, however, be in addition to the routine proficiency checks as is prevalent.	Acceptable.
3)	The operator should carry out random checks of Cockpit Voice Recorder, Flight Data Recorder and Digital Flight Data Recorder and the DGCA should ensure compliance thereof.	Acceptable.
4)	The training programme of the operator ought to inculcate a sense of cockpit discipline amongst the pilots in order to ensure smooth and efficient operation of the flight with meticulous observance of stipulated procedures.	Acceptable.
5)	Indian Airlines training programme should emphasise the need for correct call-outs by pilots and under no circumstances the pilot should indulge in wrong and inappropriate call-outs.	Acceptable.
6)	The Indian Airlines training programme ought to provide that the pilots should be guided by available navigational aids rather than the visual ground fixes specially on an IFR flight.	Acceptable.

7)	Indian Airlines should include an exercise in the syllabus for simulator training as regards the pilot's reaction to the triggering of the GPWS.	Acceptable.
8)	Co-pilots training ought to match with that of the Pilot-in-Command since the former is acting as a safety pilot and may be required to take charge should it be so required.	Acceptable.
9)	The operator ought to hold flight safety meetings regularly and the entire Directorate of the operator requires restructuring and revamping so as to be more effective in the matter of flight safety.	Acceptable.
10)	Periodic meetings between the Operations Manager, Flight Safety, and the Line Pilots ought to be arranged so as to derive benefit from the experiences of other pilots.	Acceptable.
11)	Proper liaison be maintained between the Flight Despatch, Operational Personnel including engineering and the Flight Safety Directorate of the operator by way of meetings at regular intervals.	Acceptable.
12)	The career pattern of pilots as is existing today with the operator (Indian Airlines) ought to be reviewed in the light of observations made in the report.	Acceptable.
13)	The operator through their training programme ought to encourage and impress on junior pilots and convince them that they not only have the right but indeed have the responsibility to speak up if they disagree with senior pilot's action. They must be reassured that they will not suffer displeasure or recrimination for doing so.	Acceptable.

14)	The senior pilots must equally be told that if they do not accept or indeed ridicule a junior pilot's actions in this regard then their own behaviour is unacceptable to the airline.	Acceptable.
15)	The operator must inculcate in the whole body of the pilots the philosophy of team work while operating a flight.	Acceptable.
16)	Cockpit Resource Management Course ought to be introduced without any further loss of time and if necessary even an outside management consultant may be approached for proper and effective guidance in regard thereto and all pilots are to undergo the same course in order to promote better cockpit management for safe flight operations.	Acceptable.
17)	The cabin crew training programme should be standardised and no departure from the prescribed training syllabus ought to be permitted.	Acceptable.
18)	The operator should ensure that all mandatory documents are upto date and carried on board. The DGCA Airworthiness Officers should carry out random checks and monitor compliance of the same.	Acceptable. This is already in force.
19)	All Boeing 737 Aircraft operating in the country and registered by the Director General of Civil Aviation should be fitted with Digital Flight Data Recorder as also Emergency Locator Transmitters capable of impact as well as water activation.	Acceptable. This reommendation has already been accepted and is being implemented.
20)	Calcutta Airport being a major Boeing 737 aircraft maintenance base, ought to be provided with all necessary spares and trained personnel for	Acceptable.

	effecting proper checks upto Check-I level so as to avoid carrying forward of any snag and for other similar stations the situation ought to be reviewed forthwith.	
21)	Proficiency checks of Air Traffic Controllers should be carried out periodically at least once a year and the Air Traffic Controllers should also undergo refresher courses once a year.	Acceptable.
22)	The performance of the ATCOs ought to be monitored regularly by the National Airports Authority and all remedial measures be taken immediately and if required further training be arranged for without any financial repercussions.	Acceptable.
23)	Periodic monitoring of ATC tape so as to check the proficiency of ATCOs should be conducted by the National Airports Authority and the DGCA should also monitor the same by way of random checks.	Acceptable.
24)	The National Airports Authority should arrange for familiarisation flights for all ATC personnel more frequently in consultation with the operators operating in the country.	Acceptable. DGCA has already approved 250 familiarisation flights to ATCOs per year.
25)	Periodic medical check-ups of ATCOs ought to be introduced immediately.	Acceptable.
26)	National Airports Authority should envisage specific duty hours for the ATCOs taking into consideration the fatigue factor.	Acceptable. The existing swing shift system of NAA will be revised to provide adequate rest.
27)	The training programme of ATCOs ought to contain a syllabus through which the ATCOs can familiarise themselves with the cockpit instruments relating to navigational and ground aid facilities.	Acceptable. This has already been actioned at the CATC to provide for ATCOs to familiarise cockpit instrumentation relating to Radio Navigational Aids.

28)	National Airports Authority should carry out calibration of all navigational and landing aids at the frequency stipulated by ICAO.	Acceptable. The calibration of Radio Navigational Aids is carried out as per ICAO recommendations. There has been no compromise on this aspect.
29)	National Airports Authority should ensure that only trained and formally rated Air Traffic Controllers handle the traffic.	Acceptable. NAA will further streamline the ratings procedure all over the country.
30)	National Airports Authority should clearly lay down the duties and responsibilities of Aerodrome Assistants and Air Traffic Control Officers.	Acceptable.
31)	Search and rescue ought to be included in the syllabus for training of appropriate personnel by the National Airports Authority.	Acceptable. This has already been done by NAA and the first batch of eight officers has already been trained. This course will be run on regular basis at CATC.
32)	Status indicator lights ought to be maintained in serviceable condition at all times in all airports without any differentiation.	Acceptable.
33)	Locator beacons at ILS markers may be provided at Imphal airport and also at other hilly terrain airports.	Acceptable. Will be examined by NAA.
34)	ATC tape recorder ought to be provided at Imphal Airport without any further loss of time. As a matter of fact, this particular facility should be made available to all airports having scheduled Airline operations.	Acceptable. The ATC tape recorder at Imphal has now been provided. For other airports, action is in hand to provide four channel/multi-channel tape recorders depending upon the necessity where scheduled Indian Airlines flights are operating.
35)	The National Airports Authority would be well-advised to prepare periodic	Acceptable.

	maintenance schedules for all navigational, communication and landing aids and safety services. Periodic checks be carried by only trained personnel.	
36)	As far as practicable there should be two Air Traffic Controllers available at the Control Tower during the flight movements at least at stations where all ATC functions are combined in one unit as also at the Area and Approach Control Units where radar facility is available.	Acceptable.
37)	The National Airports Authority must make available the instrument let down charts to the DGCA for its approval.	Acceptable. DGCA has issued instructions in this regard to vet the charts prepared by the NAA and scrutinised by a team comprising of DGCA, NAA and the users.
38)	Instrument let down charts of airports specially in the hilly terrain ought to be reviewed by National Airports Authority in consultation with the operator and seek the approval of DGCA.	Acceptable. Instrument let down charts of airfields in the North-East Region/Hilly Region are being reviewed. For this again the DGCA has created a small team comprising of DGCA, NAA and the users.
39)	Necessary equipment should be installed by the Meteorological Department for assessment of runway visual range as also cloud base at Imphal Airport as also other airports in hilly terrain.	Acceptable.
40)	The Flight Inspection Directorate of DGCA should be restructured to carry out frequent proficiency checks of the airline pilots on various types of aircraft and the ATCOs.	Acceptable.
41)	The Air Safety Directorate of DGCA should be strengthened to make it more effective in discharge of its	Acceptable.

vital functions relating to safety of aircraft operations.

42)	The one man Accident Prevention Cell currently existing in DGCA is totally inadequate to discharge the vital role of accident prevention and as such it should be restructured and strengthened without any loss of further time.	Acceptable.
43)	DGCA should have an separate air accident prevention cell manned by persons not below the rank of Senior Air Safety Officer at every major airport of the country.	Acceptable.
44)	The implementation of the earlier recommendation in regard to licensing of ATCOs and Aerodromes should be effected forthwith by creating an adequately staffed new wing in the Office of the Director General of Civil Aviation.	Acceptable.
45)	The DGCA should ensure inspection of the aerodromes at least once in two years.	Acceptable.
46)	DGCA should coordinate meetings with the Operators and the National Airports Authority in regard to Flight Safety inclusive of engineering aspects.	Acceptable.
47)	The DGCA being the regulatory authority ought to be revamped so as to be able to discharge its regulatory functions in terms of the Aircraft Act and the Rules framed thereunder effectively.	Acceptable.
48)	Director of Airworthiness of DGCA should exercise strict supervision by carrying out more frequent spot checks for better quality control in all relevant areas.	Acceptable.

Accident to Indian Airlines Boeing 737 Aircraft VT-EFL on 16th August 1991 Near Imphal, Manipur

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Shri A.K. Sinha

30th April, 1992

INDEX

ANNEXURES

ABBREVIATIONS USED IN THE REPORT

ALTP	Airline Transport Pilot's Licence
ATC	Air Traffic Control
ATCO	Air Traffic Control Officer
CATC	Civil Aviation Training College
CTE	Central Training Establishment
CVR	Cockpit Voice Recorder
DARA	Director of Air Routes and Aerodromes
DFDR	Digital Flight Data Recorder
DME	Distance Measuring Equipment
ELT	Emergency Locator Transmitter
FDR	Flight Data Recorder
GPWS	Ground Proximity Warning System
IFR	Instrument Flight Rule
ILS	Instrument Landing System
IMC	Instrument Meteorological Condition.
LOFT	Line Oriented Flying Training
MDA	Minimum Descent Altitude
MEL	Minimum Equipment List
MORA	Minimum Operating Route Altitude
NDB	Non-Directional Beacon
PIC	Pilot-in-Command
P1	Commander
P2	Co-pilot
QAR	Quick Access Recorder
VFR	Visual Flight Rule
VMC	Visual Meteorological Condition
VOR	Very High Frequency Omni Range

INTRODUCTION

It has happened again - on Friday the 16th August, 1991, the nation was stunned over the broadcast on All India Radio and Doordarshan in regard to a major air accident wherein there were no survivors. This time again it is a scheduled flight of a scheduled operator - Indian Airlines and the flight being IC-257 from Calcutta to Imphal.

After the Kanishka accident in June 1985, the country breathed a sigh of relief at least for nearly three years but it has started again and in a consistent fashion from August, 1988 onwards. In July, 1988, Pawan Hans Westland helicopter on a routine flight from Jammu to Vaishno Devi crashed, in which all the seven people unfortunately while on a pilgrimage died. In August, 1988, the Dauphin helicopter belonging M/s Pawan Hans crashed near Pondicherry. Two several accidents thereafter in October, 1988 within a matter of few hours stunned the nation and the operators were Vayudoot and Indian Airlines. The occurrences being at Guwahati and Ahmedabad respectively. Again in September, 1989, a Dornier aircraft belonging to Vayudoot also crashed near Pune leaving no survivors. Within a period of three months there was the Pawan Hans helicopter crash in December, 1989, near Patna. That is not the end of the accidents in our Civil Aviation sector. In February, 1990, one of the most serious air accidents of a most modern aircraft (A-320) did take place at Bangalore in which 92 persons died though providentially, however, 54 persons could escape the fatality. The next in the line is in August, 1991, at Imphal killing all 69 persons on board including the crew.

Considering the above data, there were thus, in fact, eight accidents in three years between July, 1988, to August, 1991, in which 363 valuable lives were lost.

The time has, therefore, now come to consider seriously as to the happenings in the Civil Aviation sector in the country and a proper introspection ought to be effected without losing any further time - introspection to detail out our manner and method of working so far as the civil aviation industry is concerned in the country. Courts of Inquiry have been constituted in the past - inquiry reports have also come. I am sure the Government must have also implemented quite a good number of the recommendations of those Courts of Inquiries, but practicability of the situation, however, demands more and not to be content with the recommendations or implementations thereof. It is at this stage that this introspection is required - there must be something wrong somewhere as otherwise consistently from August, 1988 to August, 1991, so many fatal accidents would not have been there. We should not be content with what we have done but we will have to consider as to what is to be done in the matter of prevention of future accidents of this nature. Human lives are precious and invaluable. Monetary compensation or a word of sympathy will not do - we will have to rise up to the occasion to stop the recurrence of the same, which is otherwise avoidable in nature. The sense of discipline ought to be inculcated in such a way so as to restore the feeling of confidence in our national airline which at present is in a gradual decline and I suppose no blame can be attributed to the travelling community of the society, moreso by reason of the happenings in the aviation industry of the country in the recent past as narrated above. Incidentally, it is not out of place to mention that apart from the incidents noted above, which turned out to be fatal, there are very many minor ones (not so fatal, but could have been so) as appears from the media.

I am not trying to impute any failure on anyone but there is no denial of fact that a feeling of insecurity is gradually gaining ground in the minds of the people as regards the safety of air travel in this country. I am conscious of the fact that the number of accidents in our country may not be that much as is in some other countries but that in my view cannot be a solace - that ought not

to give a sense of complacency in us so that we can take things as they are and leave it for the future to do the needful. The time and the hour has come for us to rise up to the occasion and do our utmost to save such fatalities.

The effort of the Government in the matter of prevention of such fatalities, however, cannot but be appreciated. No sooner the accident occurred at Imphal, the Minister of Civil Aviation and Tourism announced over the media that this accident shall be investigated by a Judge of the High Court and in pursuance whereof I was appointed to head the Court of Inquiry under Rule 75 of the Aircraft Rules 1937 with two assessors - Shri B.P. Baliga and Wg. Cdr. P. Ashoka, one belonging to the engineering discipline and the other a very renouned test pilot of the country. In terms of the notification, the time to complete the inquiry and to make the report was stated to be 31st December, 1991, but subsequently by two several notifications dated 20th December, 1991 and 31st March, 1992, the time to make the report was extended upto 30th April, 1992. A copy of the original notification dated 26th September, 1991 is however, annexed to this report for convenience sake and is marked with letter 'A'.

Furthermore, the subsequent request of the Government to the Court to visit Australia and Singapore so as to have a comparative analysis of our civil aviation system goes to show in my view, the sincerity of the Government in the matter of safety of the air passengers.

It is to be noted that at the request of the Government, I did visit Sydney so as to undertake a study of the Civil Aviation Industry in Australia and on my way back home I did also visit, though for a short while, Singapore to appraise myself of the systems followed by the two most renouned airlines of the world today, namely, the Qantas Airways and Singapore Airlines.

Briefly stated it has been a well-worth visit to Australia and Singapore: How an airline operator engages itself in its operational sphere having due regard to the safety aspect is seen to be believed. The culture, the system control, the outlook, the sincerity for the purpose together with the devotion to the concept of air passengers safety needs special mention.

As regards Qantas Airlines, the thing which is of utmost importance is the outlook of Qantas culture. Actions shall have to be taken against any impropriety or deviation from Qantas culture, but that should not be punitive in nature - it is not what has happened but how to prevent the recurrence of the same - this particular outlook has brought Qantas the name and fame as they are enjoying today throughout the globe. Another redeeming feature of Qantas culture is the reliance on to the pilots' union: the management in the event of a departure of the flying norms though takes note of the situation, but it is the union which, in fact, takes care of the situation. Confidence on to the union to this extent, cannot but demand praise and appreciation. In the event, however, there is recurrence of such a deviation from the flying norms more than one occasion, it is the Qantas culture again that would prompt the management to consider the matter in its retrospect - analyse the situation including the training aspect and if it is so felt necessary then and in that event the trainer himself gets a further training to impart training to the flying crew - an unique effort for safety of air passengers.

Does the Operator in our country goes to this extent that a small deviation needs that much of care and attention - do we have the time, energy and the inclination - the answer probably be not in the affirmative. Noteworthy here that it is the operator and not the regulatory authority which takes this much of pain to study the entire situation and see that the deviations, however, small in nature do not recur again - public safety is predominant in Quantas culture. We do also have in our national airlines a Directorate of Air Safety, but unfortunately the Air Safety Directorate does not

even hold a meeting for a period of three years. Can it be said to be a situation which is conducive to public safety - my answer unfortunately cannot but be in the negative.

I cannot but help noting another aspect even at this juncture concerning the executive pilots. As in our system, the executive pilots in Qantas Airlines do also fly, As a matter of fact the entire operational management is being administered by the flyers only - but there exists a difference and the difference being - whereas the executive pilots in our country undertake flying just like line pilots, if not slightly more, Qantas however does not allow its executive pilots to fly more than one-third of what a line pilot does: the reason is not, however, far to seek - the entire administrative super structure consists of the executive pilots and if they fly as the line pilots do, where is the time to devote on to the organisational aspect and other administrative works - where is the time to think and evolve the best safety methods.

Incidentally, against a pointed question asked by me to Capt. Mehta to the same effect, the answer of Capt. Mehta was that sufficient time is available to look into the administrative and organisational aspect also - there lies probably the difference : we take things as they are : we have no intention nor any inclination to give it a thought about the whole situation. We want to continue with the existing system as they are : attitude of the Australian Civil Aviation Industry is, however, slightly different - It is a safety-oriented approach and they evolved the system in such a way so that the entire system can develop in its proper perspective having due regard to the safety aspect. I will be failing in my duty if I do not mention, however, here itself, that all the executive pilots are duly compensated in terms of money and they get a fixed remuneration having due regard to the flying time with which the executive pilots otherwise would have been associated. The entire super structure, therefore, of our national operator needs a change and it is for the Government and the operator to look into the matter as otherwise there will only be a compromise with the safety of air passengers.

The operator's organisational structure needs to be revamped so that a culture is introduced which by itself would negate any chance or risk and will promote safety. The details of the study undertaken by me at Australia and Singapore will appear in this report, suffice it to note, however, that the regulatory authority ought to exist only for the purpose of supervision of the whole system and it is the operator which needs to concentrate and evolve the system of safety by which air travel in this country will be as safe as in Australia or in Singapore. I am not prepared to accept that we lack efficiency in any way, but what we lack is the system control and the management and the operator should now give it a thought in order to bring home the concept of safety in the minds of air passengers which is in a gradual decline at present.

2. THE UNFORTUNATE FLIGHT

Indian Airlines flight IC-257 from Calcutta to Imphal and then on to Dimapur was a scheduled flight of the operator. The aircraft used was a Boeing 737 having registration number VT-EFL under the command of Capt. Sekhar Haldar and Capt. D.B. Roy Choudhury was the Co-pilot. In accordance with usual practice, flight briefing was effected at the flight despatch of the operator and records to that effect were duly produced before the Court of Inquiry. There was also pre-flight medical checking of both the pilot and the co-pilot and the usual Boeing 737 flight plan was made over to the flight crew members which reads as follows:-

Check Points & Radio Aids	Dist. NM	Time MTS
VECC		02
FIR CF / FR	28	05
TOC	49	08
BAVAN	12	01
AGUNO	32	04
VGCM	39	05
FIR FR/CF	07	01
VEAT	21	03
ABM VEKU	110	15
TOD	07	01
O/HEAD VEIM	38	07
DES G/L VEIM		08

As per the flight plan, the aircraft had 7,900 kgs of aviation fuel though the requirement was of 7785 kgs which takes note of APU fuel, alternate fuel, holding fuel, manoeuvre and taxi fuel. From the actual trim sheet, it appears there was also in fact 7,900 kgs. of fuel on board the aircraft and as such it can safely be concluded that the aircraft had sufficient fuel to operate the sector Calcutta to Imphal as a scheduled flight No.IC-257.

The flight crew detailed to operate the flight consisted of Capt. Sekhar Haldar as the Commander, Capt. D.B. Roy Choudhury as the Co-pilot with four cabin crew members Mrs. Suriya Sen; Mrs. Sipra Majumdar; Miss Minoti Ray and Miss Sonali Roy. There were altogether 63 passengers inclusive of one child on board of which 31 passengers with the child were booked for Imphal and 31 for Dimapur.

The scheduled departure time of the flight from Calcutta was 1130 a.m. (IST) on 16th August, 1991 and the aircraft, in fact, taxied out at 11.50 a.m. and it was airborne at 11.54 a.m. from runway 19L at Calcutta airport. The ATC tape-transcript depicts that initially the aircraft was cleared to flight level 70 (7,000 feet) on track and from flight level 70 to flight level 150 (15,000 feet) under Radar and further from Dhaka Control. The materials on record show that the aircraft was cleared to Imphal via route B-593 and W-54 with flight level 290 (29,000 feet) having total flying time 60 minutes for this particular sector (Calcutta-Imphal). The aircraft in accordance with the usual flight plan did call at Comilla and reported "approaching overhead Alpha-Alpha Tango". The Cockpit Voice Recorder also depicts that the aircraft did contact abeam Silchar and thereafter came in contact with Imphal at 12:34:45 hours (IST). At this stage, the aircraft communicated the revised ETA to Imphal and asked for descent clearance, which was granted. At 12:36:57 hours (IST) the ATCO at Imphal cleared the flight IC-257 to descend to 10,000 feet and asked to report overhead VOR for ILS Runway 04. At 12:39:45 hours (IST) the aircraft (IC-257) intimated the Tower that the aircraft is now 12 miles inbound at 10,000 feet and the Tower at Imphal asked the Pilot (IC-257) to maintain and report overhead VOR. Immediately thereafter, however, within two seconds the pilot asked the ATCO as to whether they can set course directly outbound for let down and the ATCO at Imphal did permit the same. AT 12:41:29 hrs. (IST) the aircraft transmitted that they are approaching overhead and three seconds thereafter the Tower transmitted a message

which reads; "understand you are proceeding on a radial 217 for ILS" and four seconds thereafter the aircraft replied as affirmative? The Tower however immediately asked to give a call commencing the procedure turn.

At 12:42:13 hrs. (IST), the aircraft was asked by Imphal ATC to proceed outbound for ILS approach for runway 04 descending to 5,000 feet. In the mean time, Imphal ATC allowed IC-890 to enter runway 04 for take off to Guwahati. Proper separation was given between IC-890 (departing aircraft) and IC-257 the arriving aircraft. This aircraft was also informed about the traffic.

At 12:44:50 hrs. (IST), the aircraft (IC-257) reported commencing procedure turn. However, after departure of IC-890, Imphal ATC tried to contact IC-257 but there was no response. After waiting for some time and giving several calls, Imphal ATC started emergency procedure followed by search and rescue action.

At about 1700 hrs. (IST) Imphal ATC came to know through police wireless that the aircraft (IC-257) was found to have crashed on a hill (Thangjing) at a distance of approximately 20.5 NM on the approach path of runway 04 of Imphal Aerodrome. The estimated coordinates of the crash point are Lat. 24° 29' 54"N Long. 93° 40' 20"E. The aircraft crashed at 12:46:23 hrs. (IST) under inclement weather condition having low cloud, occasional rain.

After the impact with the hill the aircraft was completely destroyed. All the 69 persons on board lost their lives. There was post crash fire and as appears from the materials on record the wreckage of the ill-fated plane with nose and front section disintegrated into pieces and were found South-West of Imphal aerodrome at a distance of approximately 20.5 nautical miles and about 300 feet below the highest point at that location in the form roughly of an inverted 'L'. The long arm of inverted 'L' stretched to approximately 300 to 400 metres and short arm stretched 50 to 75 metres as per visual estimate. There were burnt patches and the

area looked brown. The direction and spread of the wreckage indicated a head-on-crash and a graze on the slope of the hill. The vegetation and trees were either burnt due to sprinkling of aircraft fuel and hot debris immediately after the crash or were cut in the direction of the hill at the time of the crash and was found limited to the crash site. The factum of existence of unburnt material including currency notes points to a definite direction that the fire was after the crash. The damage to the aircraft was total by reason of disintegration due to the impact with the hill.

Relevant extracts of the tape transmission as appears from the Cockpit Voice Recorder of the ill-fated aircraft ought to be noted at this juncture and as such the same are reproduced below. The details of the entire transmission, however, would appear from a schedule annexed to this report and marked with Letters 'AA'.

The relevant extracts of CVR tape transcript

UTC TIME (hr:min:sec)	**FROM**	**TO**	**TEXT**
06:48:47	Agartala	IC-257	257 Roger report passing Alpha Alpha Tango.
06:48:52	IC-257	Agartala	Agartala 257
06:48:54	Agartala	IC-257	257 copied O.K. report passing Alpha Alpha Tango.
06:51:44	IC-257	AAT	Roger India 257 approaching overhead Alpha Alpha Tango.
06:51:52	Agartala	IC-257	257 Roger you may call and report in contact with Imphal.
06:51:59	IC-257	Agartala	Not with Silchar.
06:52:01	Agartala	IC-257	As you like with Silchar O.K.
06:53:42	IC-257	Imphal	Imphal 257 Imphal.

06:53:49	Imphal	Other Stn.	Observation 0630 270/03 kts. visibility 7 kms., cloud 3 Octa 800 feet 5 Octa 1800 feet 8 Octa 10000 feet temperature 24 dew point 22 QNH 1009, 2980.
06:54:22	IC-257	Imphal	Maintaining level 290 from Calcutta to your field departure from Calcutta was at time 0624 estimating abeam Kumbhigram at time 0708 overhead your field at 0716. Will you go ahead with latest weather aircraft is Echo Foxtrat Lima and transit figure is 31.
06:54:47	Imphal	IC-257	India 257 Roger at this time as per weather report wind 270°/03 kts., visibility 7 kms., cloud 3 Octa 800 feet 5 Octa 1800 feet 8 Octa 10000 feet, temperature 24, dew point 22 QNH 1009, 2980.
06:55:09	IC-257	Imphal	Confirm with QNH only.
06:55:11	Imphal	IC-257	1009.
06:55:33	Dimapur	IC-257	Weather briefing please cloud 2 Octa 600 feet 3 Octa 1500 feet 7 Octa 9000 feet temperature 27 dew point 25 QNH 1004 HPA.
06:55:59	IC-257	Dimapur	Aab only give the visibility and surface wind.
06:56:04	Dimapur	IC-257	Surface wind 360°/10 kts. visibility 5000 metres five zero zero zero metres.
06:56:15	IC-257	Dimapur	Roger copied O.K. will be our E.T.A. Imphal is 072.
06:56:37	P1	P2	Imphal low clouds ache na?

06:56:39	P2	P1	3 Octa 5 Octa.
06:58:34	IC-257	Silchar	Imphal India 257 negative traffic with Silchar descent from level 290.
06:58:43	Imphal	IC-257	Roger confirm 257 or 252.
06:58:46	IC-257	Imphal	257 this is 257.
06:58:51	Imphal	IC-257	Victor 257 Roger descent to flight level 135 report reaching.
06:58:56	IC-257	Imphal	Roger 135 call you reaching.
06:59:33	IC-257	Imphal	Imphal 257 descending to 135.
06:59:37	Imphal	IC-257	257 Roger.
06:59:50	Imphal	IC-256	Time of observation 0630 wind 270/03 visibility 7 kms. cloud 3 Octa 800 feet 5 Octa 1800 feet 8 Octa 10000 feet temperature 24 dew point 22 QNH 1009.*
07:00:07	IC-256	Imphal	Roger.*
07:00:33	IC-257	Imphal SSB	Imphal Imphal India 257.
07:00:40	IC-257	Imphal SSB	Imphal 257 ETA Imphal 0725.
07:00:50	Imphal SSB	IC-257	ETA Imphal 0725 Roger.
07:00:52	IC-257	Imphal SSB	That is affirmative. Please inform engineering on arrival required ground electrical. I say again on arrival required ground electrical.
07:01:09	Imphal SSB	IC-257	At the time of arrival you require electrical ground electrical.

07:01:29	IC-257	Silchar	Sir descending to 135 in coordination with Imphal we will call you back abeam Kilo Kilo Uniform.
07:01:40	P1	P2	O.K. descent checks.
07:01:42	P2	P1	Anti-ice off, air-conditioning and pressurisation set for landing at - - in auto mode, instrument cross-checked EPR 2.1 go around EPR set, both sides bug at one two twenty-two.
07:01:52			Turn left down wind surface wind zero zero 10 kts. - - -
	P2	P1	Approach briefing.
07:01:59	P1	P2	Visual - - or otherwise we will go overhead 10,000 feet then on the hold cleared to 8,000 feet and 070 this will be tear drop entry inbound 217 after that leaving VOR 217 8000 to 5000 feet check time two and half minute and then in descending turn to 4200 and then further descent on interception glide slope only correction 5,000 feet then a procedure turn after that further intereception with glide slope descending to decision height 224. Then in case of missed approach climb straight ahead to 4200 feet then turn left to join VOR holding climbing 8,000 feet.
07:04:12	Silchar	IC-257	257 Silchar go ahead.
07:04:14	IC-257	Silchar	We are abeam Kilo Kilo Uniform in contact with Imphal.

07:04:17	Silchar	IC-257	257 Silchar change over to Imphal good afternoon.
07:04:48	IC-257	Imphal	Our revised overhead Imphal time is zero correction one two, 0712.
07:04:56	Imphal	IC-257	Roger 0712.
07:05:00	IC-257	Imphal	And level approaching one three five further descent.
07:05:04	Imphal	IC-257	Roger descent to flight level 115 transition level.
07:05:07	IC-257	Imphal	Roger 115.
07:06:38	P2	P1	In case of diversion field is Guwahati, fuel is 2.6 (?) tonnes.
07:06:47	P1	P2	Level 115 further descent.
07:06:50	IC-257	Imphal	Reaching 115, 257 further descent.
07:06:54	IC-257	Imphal	Imphal India 257, 115 further descent.
07:06:57	Imphal	IC-257	257 now descent to one thousand correction one zero thousand (altitude horn) QNH 1009 HPA. Report over VOR for ILS runway 04.
07:07:07	IC-257	Imphal	Roger QNH 1009 cleared to one zero thousand VOR for ILS.
07:07:28	P1	P2	QNH 1009
07:07:30	P2	P1	1009
07:08:44	P1	P2	You are exactly - - This is 25 miles Roger Aye Ekta Hill Range Oye Ekta Hill Range Do Tor Majh Khanne.

07:08:48			Roger
07:09:43	Imphal	IC-257	257 Imphal report your position.
07:09:45	IC-257	Imphal	Now we are one two miles inbound at ten thousand 1009.
07:09:53	Imphal	IC-257	O.K. maintain report overhead VOR.
07:09:55	IC-257	Imphal	Roger overhead, can we set course directly outbound for let down.
07:09:59	Imphal	IC-257	Roger, you are cleared.
07:10:01	IC-257	Imphal	Roger.
07:11:25	P1	P2	Flap 1.
07:11:26	Imphal	IC-257	Indair 257 report your position.
07:11:29	IC-257	Imphal	We are approaching overhead.
07:11:32	Imphal	IC-257	Understand you are proceeding on a radial 217 for ILS.
07:11:36	IC-257	Imphal	That is affirmative.
07:11:37	Imphal	IC-257	Roger give a call commencing procedure turn.
	IC-257	Imphal	Roger.
07:12:09	P1	P2	Hey we might as well descend also Naa.
07:12:13	IC-257	Imphal	257 on the outbound leg for the let down and descending to 5,000.
07:12:19	Imphal	IC-257	Give a call commencing procedure turn crossing outer marker outbound.

07:13:48	P1	P2	What is heading for procedure turn?
07:13:50	P2	P1	Procedure turn heading is 172.
07:13:54	P1		Position outer marker out-bound.
07:13:55	IC-257	Imphal	257 will call you inbound.
07:13:58	Imphal	IC-257	Roger request your level.
07:14:01	IC-257	Imphal	We are now 6,500.
07:14:04	Imphal	IC-257	Roger give a call at 5,000.
07:14:07	P1	P2	Procedure turn heading.
07:14:09	P2	P1	172.
	P2	P1	Cross Checked.
07:14:38	P2		Two minutes up.
	P1		O.K.
07:14:39	Imphal	IC-257	India 257 request altitude passing.
07:14:42	IC-257	Imphal	5,000, 5,900 feet.
07:14:44	Imphal	IC-257	Confirm 5,000.
07:14:45	IC-257	Imphal	Affirmative.
07:14:46	Imphal	IC-257	Roger.
07:14:48	Imphal	IC-257	Give a call commencing procedure turn.
07:14:50	IC-257	Imphal	We are in the procedure turn, we will call you inbound.
07:14:52	Imphal	IC-257	Roger call inbound.
07:14:59	P1	P2	ILS preparation.

07:15:00	P2	P1	Rabit Ears.
07:15:01	P1	P2	ADF.
07:15:02	P2	P1	Inbound.
07:15:03	P1	P2	035.
07:15:04	P2	P1	QNH 1009
07:15:05	P1	P2	1009.
07:15:06	P2	P1	Radio altimeter setting 2.2.
07:15:07	P1	P2	224
07:15:09	P1	P2	O.K.
07:15:11	P2	P1	Marker sènsitivity low.
07:15:13	P2	P1	I will give you ILS frequency.
07:15:15	P1	P2	Go ahead.
07:15:19	P2		110.3
07:15:20	P2		110.3
07:15:23	P2		Markers ON.
07:15:24			(Altitude horn sound).
	P2		ILS preparation completed.
07:15:25	P1	P2	Altitude
07:15:27	P1	P2	Four two zero zero.
07:16:04	Imphal	IC-257	257 Imphal for your information rain is approaching from the East, part of the airfield is under rain.
	IC-257	Imphal	Roger.
	P2		Roger.
07:16:16	Imphal	IC-257	257 request level now

07:16:20	Whoop Whoop Pull Up Whoop Whoop Pull Up Whoop Whoop Pull Up - - - -
07:16:23	Whoop Whoop Pull Up Whoop Whoop Pull. Crash sound.

On the basis of the above transcript it therefore appears that the aircraft VT-EFL (IC-257) from Calcutta to Imphal crashed around 12:46 hrs (IST) at Thangjing hill near the Imphal airport. As regards the steps for search and rescue, the same would be dealt with separately later in this report.

3. POST-MORTEM EXAMINATION OF CRASH VICTIMS

IC-257 having taken off from Calcutta on 16th August, 1991, crashed near Imphal around 12:46 hrs (IST) killing all 69 persons on board the flight consisting of 63 passengers inclusive of one infant passenger and 6 members of the crew. From the report of Wg. Cdr. Dr. J.K. Gupta, Assistant Director General Medical Services in the Office of the Director General of Civil Aviation, it appears that four bodies were brought down, identified and post mortem work was conducted on the night of 17th August, 1991. The next three days i.e. 18, 19 and 20th August, 1991, were spent in conducting the post mortems of the victims as and when they were brought down from the crash site. The post mortems were conducted at the Regional Medical College, Mortuary Imphal by a team of doctors of the Department of Forensic Medicines of the college lead by Dr. L. Femate, Associate Prof. of Forensic Medicine. All the bodies were duly identified and forensic examinations were had before the post mortem examinations of the bodies. The evidence on record of Dr. Femate unmistakably suggests that there was no chance, considering the injuries on the bodies, of life, immediately after the crash. Dr. Femate also stated that apparently whereas one or two bodies bore no sign of external injury, but by reason of the intensity of the internal injuries, question of there being any chance of life was not there and the death was instantaneous. According to Dr. Femate the burn injury may be simultaneous though burn injury alone is unlikely to cause death. The traumatic injuries apart from the burns were immediately fatal in nature. On the issue of the cause of injury, Dr. Femate's definite evidence is that almost all the injuries have been caused by the impact against the front seats and the back metal of the seats would be capable enough to cause the same.

While it is true that no carbon monoxide deposit tests were carried out at the Imphal Mortuary, the samples of the lungs of the victims particularly of the pilot and cabin crew were made over to the appropriate authority for being tested at the Institute of Avia-

tion Medicine at Bangalore and Wg. Cdr. Gupta's report to this Court expressly point out that samples of tissues from the bodies of the pilot and co-pilot as well as one cabin crew member were collected and sent to IAM Bangalore for examination. Wg. Cdr. Gupta on the basis of the Toxology Report from IAM noted that, there is no evidence of ante-mortem injury burns or carbon monoxide toxicity. For convenience sake the remarks column of the report of IAM autopsy is quoted herein below:-

> "All tissues show autolytic changes. The changes in the lungs are consistent with traumatic etiology. No evidence of ante-mortem injury/burns or carbon monoxide toxicity."

A copy of the report of Wg. Cdr. J.K. Gupta, however, is also annexed hereto and marked with Letter 'B'.

The observations of Wg. Cdr. Gupta who attended the post-mortem examination along with two doctors of the operator (Indian Airlines), namely, Dr. Das and Dr. Bhattacharya ought for convenience sake be noted at this juncture in regard to the injury pattern on the victims and the same are as follows :

> "i) Practically all the victims had a crash injury of the head and face, hyperflexive injuries of the sternum and dorsal vertebrae.
>
> ii) Massive decelerative injuries of the heart lungs, diaphragm and abdominal viscera.
>
> iii) Some distinguishable lap belt injuries of the mesentry and the gut as well as pubic symphysis.
>
> iv) The lower limbs had bilateral both bone fractures mostly in the lower 1/3.
>
> v) Most victims also had fractures of one or both arm bones.
>
> vi) There was no evidence on gross examination of carbon monoxide inhalation.

vii) There were no distinguishable ante-mortem burns. Some sprinkle burns (possibly post mortem) were noticed on the skin of some of the bodies. The charring of the few bodies (4-5) appeared to be post mortem as a result of limited post crash fire.

viii) There was no evidence of any penetrative or missile like injuries.

ix) An interesting feature was the claw hands configuration of both pilots with multiple fractures of small bones of both hands.

x) More than 60% of the bodies which were received more than 48 hrs. of the crash showed signs of putrefaction and were defaced."

As regards the medical records of the flight crew the same is dealt with under the heading "Crew Information" and as such need not be dealt with at this juncture.

4. AIRCRAFT INFORMATION :

i) General :

The Boeing 737 Jet Transport is designed to operate over short-to-medium ranges. Wing high-lift devices permit operations from airports not formerly accessible to jet transports. The 737-200 is 100 feet long and has a 93 feet wing span. The maximum operating air speed is approximately 350 knots EAS or 0.84 Mach. maximum certified altitude is 35,000 feet.

ii) Engine :

The airplane is powered by two Pratt and Whitney JT8D turbo fan engines mounted under the wings. The engine is a forward-fan-type engine with a twin-spool axial compressor. The engine has nine can-annular burners in the combustion chamber, and is provided with a multi-stage reaction-impulse turbine. The multi-stage axial compressor consists of a low pressure unit, which includes the fan stages, and a high pressure unit. The low pressure unit is connected by a through-shaft to the turbine wheels for the low pressure compressor, and the high pressure unit is connected independently by a hollow shaft to the turbine wheel for the high pressure compressor. The engine is equipped with a full length annular fan-discharge duct. A hydromechanical fuel control governs the rotor speed of the high pressure compressor, and schedules fuel flow to provide the thrust called for by the thrust lever setting in the cockpit.

The wing mounted engines assures "eye-level maintenance." The cowl panels hinge at the top of the engines or detach so that most components are accessible without a stand. Engine accessories, plumbing, wiring, ducting, and fire wall attach points for the two engines are identical.

The engine inlets are forward of dirt, dust, and other foreign material airborne in the wake of the main landing gear and flaps. The inlet environment of the wing mounted engines provides clean bleed air for the airconditioning system. The engines are located far enough outboard to clear water or slush spray pattern from the nose gear. Reverse thrust is accomplished by two hydraulically activated deflector doors which block engine exhaust gas flow and deflect the exhaust stream forward.

Engine accessories are easily reached from the ground by opening hinge mounted engine cowlings. The oil tank, fuel/oil heat exchanger, and supplementary fuel heaters are integral engine parts. Each engine has a 40 KVA generator with a constant speed drive. Pneumatic engine starters are operated by air supplied through the pneumatic manifold from either the auxiliary power unit, the other engine, or a pneumatic ground cart.

iii) Electrical :

Primary 115 Volt, 400 Hz. AC electrical power is supplied from a 40 KVA generator located on each engine. The D.C. electrical system is composed of three 50 ampere transformer-rectifier (TR) units, a 22 ampere hour battery, and a battery charger. The APU drives a single 40 KVA generator that may be used for main generator back up power in flight, and can provide power to all airplane buses on the ground.

Pilot electrical load management has been reduced to a minimum. In the event of an engine or generator failure, loads which are necessary to maintain all primary flight functions are automatically transferred from the dead bus to the remaining generator system. This continuous primary power capability allows the pilot to continue existing flight operations until he can review the electrical panel and take remedial action. Transferred primary loads will not cause an overload sufficient to trip the

remaining generator. The APU may then be started to assume the total load of the dead bus.

The DC power distribution system also has automatic transfer to preclude any interruption of power to the primary radio, flight instruments or flight controls. Ground operation electrical requirements can be supplied either by the APU or from a ground power supply. In either case, all busses can be powered.

iv) Structures:

The structure of the aircraft is designed to provide maximum strength with minimum weight. The materials most commonly used are aluminium, steel and magnesium alloys. Aluminium and fibre glass honey comb material is used extensively. The fuselage is a semimonocoque structure with the skin reinforced by frames and stringers. The fuselage consists of four sections of which the forward three contain the cockpit, passenger and cargo accommodation whereas the fourth section provides the support to the empennage. The doors are removable units which enclose various compartments of the aeroplane and which permit entry to or exit from those compartments by passengers, crew or maintenance personnel. The doors are divided for their specific purpose into several groups viz. passenger/crew doors; emergency exits; cargo doors; service doors; fixed interior doors. An electrical door warning system is provided to indicate to the flight crew that all doors are closed and properly latched before the flight. The structure of wing consists of the left wing box, centre wing box and the right wing box. Throughout the wing, the skin panels are reinforced by span-wise stringers and spars. The control surfaces along the trailing edge of each wing consist of inboard and outboard flaps, an aileron and a total of four spoilers. The fuel tanks are located in the wings and are inter-connected. The empennage comprises a dorsal fin, a vertical fin, an adjustable horizontal stabilizer, rudder and elevators. The structure of the aeroplane is protected from corrosion by application of various finishes.

v) Pneumatics

Pressurised air is bled from the engine compressor sections for cabin airconditioning (heating, cooling, ventilation), cabin pressurisation, engine starting, and thermal anti-icing. The sources of bleed air are the eighth stage compressor and the thirteenth stage compressor. Bleed air from these sources is either used separately or combined as necessary to ensure adequate air under high demand conditions. Air from the eighth stage compressor is used primarily for airconditioning, wing anti-icing, and other systems connected into the airconditioning manifold. Air from the thirteenth stage compressor supplements eighth stage air for airconditioning and supplies hot air for anti-icing the fuel heater and nose cowl. High pressure air for hydraulic reservoir pressurisation also comes from the 13th stage bleed.

Normally, bleed air is used from both engines, however, bleed air from either engine is sufficient for operation of the pneumatics systems. Airflow is also available from the compressor section of the APU for engine starting and airconditioning on the ground. The pneumatic system can also be supplied directly from a ground air cart using pressurised air from the cart for engine starting and for airconditioning.

vi) Hydraulics

The hydraulic system is divided into three functionally independent 3,000 psi systems designated 'A', 'B', and 'standby'. A fire resistant fluid is used for maximum protection against fire. System 'A' is powered by two engine driven pumps. It provides hydraulic power for flight controls, ground spoilors, inboard flight spoilors, landing gear extension and retraction, trailing and leading edge flaps, slats, nose gear steering, brakes and thrust reversers. System 'B' is powered by two electric motor driven pumps and provides hydraulic power for the flight controls, brakes, outboard

flight spoilors. In the cargo configuration, system 'B' also provides hydraulic power for the cargo door. The standby system, powered by a separate electric motor driven pump, provides backup power to the rudder control system and is also used for alternate extension of the leading edge flaps and slats. Alternate operation of the thrust reverser is provided by the standby system or by accumulator pressure.

A hydraulic system control panel installed on the pilot's overhead panel includes hydraulic pump switches, low pressure warning, electric motor pump overheat warning, and a ground inter-connect control switch. Flight controls hydraulic system switching and warning are on the overhead panel within easy reach of either pilot. The fluid quantity and pressure information indicators are located on the First Officer's instrument panel.

vii) Landing Gear and Brakes

The landing gear is a conventional tricycle dual-wheel system. Gear retraction and extension is accomplished with hydraulic components. The main gear retracts inboard, while the nose gear retracts forward. The wheels retract to from an effective wheel-well closure, sealed by a blade type seal. Inflight brake cooling is accomplished by wheel-well ventilation through vents in the outboard wheel hubcaps.

A manual extension system allows the gear to free fall down and locked by double spring bungees when the uplocks are released. A visual means for determining inflight that the landing gear is down and locked is provided by the gear viewers on the passenger airplanes. In the cargo configuration, only the nose gear viewer is available. A redundant electrical system is provided for a secondary indication that the main gears are in the down and locked position by lights located on the aft overhead panel.

Nose wheel steering is provided for directional control during taxiing using hydraulic power to turn from zero to 78° to either side.

The brake system consists of main wheel multi-disc brakes powered by the two independent hydraulic systems. A dual hydraulic brake system is provided, with the inboard wheel brakes powered separately from the outboard wheel brakes. Maximum braking efficiency is provided with a modulating anti-skid system which senses individual wheel activity during the landing and automatically controls brake pressure to each wheel. When installed, an automatic brake system provides automatic brake application on touch down. Braking gradually increases to a level selected by the pilot.

viii) Navigational Instruments

Flight instrumentation includes a flight director system that provides roll and pitch axis command information. This system is suitable to permit manual control of the airplane during lower weather minimum conditions. An approach progress display located adjacent to the flight director indicator supplies computer operating mode data. Independent compass and attitude systems are installed with in-line monitoring of the directional and vertical gyros. The low range radio altimeter system (when installed) facilitates low approach capability. Additional navigation instrumentation includes: ADF radios, VOR/localizer (with glide-slope function), marker beacon, DME, ATC transponder (when installed), and weather radar. Conventional air data instruments (Mach, airspeed, vertical speed, and altimeter) read directly from the separate pitot-static sources for the Captain and First Officer. Electric air data instruments receive information from an air data computer. The captain's and First Officer's pitot static system provides inputs to the air data computer.

ix) Communication Instruments

The communications equipment aboard the airplane is integrated into various systems utilised to convey audible information between ground facilities, the airplane's crew, and passengers. The VHF radios provide airport and airways communications. The flight interphone permits communication between flight crew members and between the flight and ground crew. The service interphone allows communication between flight crew and maintenance personnel. The passenger address system provides voice communication to the passengers or music reproduction (when installed). Selcal is provided for company-to-crew communications (when installed).

x) Auto Flight

The auto-pilot provides stabilization in pitch and roll during normal climb, cruise and approach conditions. Functions of the auto-pilot include heading and altitude control, VOR/ILS beam coupler, glide-slope coupler, and turbulence penetration. The basic mode of the auto-pilot operation permits the pilot to introduce pitch and roll commands to the auto-pilot through movement of the control column and control wheel. This feature is known as control wheel steering and is utilised in place of the turn and pitch controller.

xi) Flight Controls

The swept-back high speed wing is equipped with control surfaces and high lift devices that offer excellent flight characteristics and short-field performance. All 737 flight controls are fully hydraulic powered with simple manual reversion, except for the rudder, which operates a third hydraulic power source and separate actuator to back up the primary hydraulic dual-tandem actuator power system.

Lateral control is provided by one aileron and two programmed flight spoiler panels on each wing. The flight spoiler panels are also efficient speed brakes that may be extended at any airspeed without affecting lateral control. In addition to the flight spoilers, additional ground spoiler panels are located on the wing inboard and outboard of the engine nacelles to provide additional "Lift dumping" and deceleration after touch down. Manual reversion control forces are minimized by aileron balance tabs and single hinged balance panels.

Longitudinal control is provided by the elevators which are powered directly by two independent hydraulic power packages. In the event of complete hydraulic power loss, manual reversion will permit manual control directly to the elevators. The horizontal stabilizer trim control system provides longitudinal trim of the airplane by varying the incidence through 17 units of travel of the horizontal stabilizer. Directional control is provided through a single conventional rudder, hydraulically powered through a simple and reliable low friction cable system. In addition, a hydraulic powered standby system provides the necessary backup and eliminates rudder tabs, balance panels, and lockout mechanisms while maintaining safety and control reliability.

xii) Ice and Rain Protection

An electrical anti-icing system protects the windshield and pitot heads. Thermal anti-icing guards the leading edge slats and engine cowls.

The rain removal system consists of windshield wipers and rain repellent dispensers. Each wiper is electrically operated by a separate system to ensure that clear vision is maintained during take off, approach and landing. The rain repellent system is used in conjunction with the windshield wipers to improve visibility during heavy rain. Each window is controlled independently by separate switches.

xiii) Airconditioning and Pressurisation

The airconditioning system provides conditioned pressurised air to the cockpit, passenger cabin, lower nose compartment, both cargo compartments and the airconditioning distribution bay. Air supply to the airconditioning system is furnished in flight by the pneumatic system from either engine bleed air or the auxiliary power unit (APU). During ground operation, air is supplied from engine bleed air, the auxiliary power unit, a ground pneumatic supply cart, or a ground conditioned air supply cart. Part of the warm air supply from the engines or pneumatic cart is passed through the airconditioning packs to be cooled. The cold air is then mixed with the remainder of the warm air as required to obtain the temperature air called for by the temperature control system. This conditioned air then passes into the cockpit and passenger cabins through the distribution system.

The outflow valves are regulated to exhaust only that additional quantity of air required to maintain the desired pressure in the cabin.

The pressurisation control system provides three independent modes of operation - automatic, standby and manual. The system is electrically operated, and electrically controlled, and meters the exhaust of ventilating air to provide controlled pressurisation of the cockpit and passenger cabin, the electronic compartment, both cargo compartments, and the lower nose compartment. The system is completely automatic and under normal conditions requires no adjustment by the flight crew throughout the flight.

xiv) Fire Protection

Airplane fire protection is achieved by use of a fire detection system and an overheat detection system, supported by the fire extinguishing systems. The engine and APU fire detection systems are electrical heat sensing systems that respond to a general

overhead condition or a localized fire condition by activating warning lights and an alarm bell or an outside horn in the case of the APU.

The extinguishing system has two separate freon applications for either engine. Associated amber discharge lights on the fire warning control panel will illuminate when either the left or right bottle has been discharged or the safety relief valve has melted and bottle pressure is bled off. A separate fire extinguishing bottle is located in the APU compartment for APU fire protection. An amber light on the fire control panel illuminates when bottle pressure has fallen to approximately 250 psi. In addition, two indicator disks, a red and a yellow, are installed in the airplane skin on lower right side of the empennage to indicate thermal relief or system discharge.

Emergency equipment includes fire extinguishers, first aid kits, oxygen, megaphones, and lights for use in the event of an inflight or landing emergency. Escape slides, escape ropes, and a crash axe are installed to assist in abandoning the airplane, and to aid in rescue operation.

xv) Oxygen

Separate high pressure systems supply oxygen to the crew and passengers. Crew oxygen is a diluter-demand type. Passenger oxygen is a continuous flow system with supplemental walkaround bottles.

xvi) APU

The auxiliary power unit (APU) is installed in the aft end of the airplane fuselage, behind the pressure bulkhead, and under the horizontal stabilizer. A generator, identical to the engine generators can furnish electrical power during ground operation or can be used as a main generator backup power in flight. The APU

also provides pneumatic power for starting, airconditioning and pressurisation. A safe, accessible installation is provided, with the APU shock mounted in a sound-proofed compartment equipped with a fire detection, warning, and extinguishing system.

xvii) Warning Systems

The aural and visual warnings alert the flight crew to conditions that require action or caution in the operation of the airplane. The character of the signals used varies, depending upon the degree of urgency or hazards involved. A central switch is located on the main panel, which tests all lights and can place the lights in a bright or dim condition. In the dim position, the approach progress display has an automatic intensity control feature which will raise or lower the indicator light intensity proportionally to ambient light conditions.

Aural, visual and tactile signals are used singally or in combinations to provide simultaneously both warning and information regarding the nature of the condition. Red warning lights located in the area of the pilots' primary forward field of vision are used to indicate engine, wheel-well, APU, or cargo fire, auto-pilot disconnect (flashing), and landing gear unsafe conditions. Blue lights when bright indicate associated valves in transit or valves in disagreement with appropriate control switch.

Audible warning for airspeed limits is given by a clacker, cabin altitude by an intermittent horn, and a steady horn in flight warns that the landing gear is not down. An intermittent horn on the ground warns that the airplane is not in a take off configuration.

Stall warning is provided by a control column shaker on the captain's control column. Conditions which require caution of the flight crew are indicated by means of amber caution lights.

xviii) Flight Recorders :

Flight Data Recorder:

This aircraft is fitted with 5 parameters engraved foil recorder Flight Data Recorded (FDR) manufactured by Lockheed Aircraft Services as Model 109D. FDR is installed above the ceiling panel at station 947, left of the airplane centerline. But the accelerometer is installed on the forward side of the left main wheel well forward bulkhead. FDR recorder spool is capable of recording permanently following 5 parameters for a duration of minimum 200 hours :-

1. Airplane altitude;
2. Air Speed;
3. Magnetic heading;
4. Vertical acceleration; and
5. Elapsed time.

The power supply required for FDR is 28V DC, 115V AC and 26V AC.

The Flight Recorder may be turned ON and OFF manually by the toggle switch on the flight recorder test module. If it has not been turned manually, it will be turned on automatically by the oil pressure switch when one engine is started and turned OFF when the engine is stopped. The parallel circuit through the ground sensing squat to the relay turns the recorder ON when the airplane lift the ground.

Flight Recorder test module and the monitor panel are located on P-5 panel. The monitor circuit monitors application of power and tape movement. It also furnishes 400 Hz signal (beep) to the monitor unit when the flight recorder is operating. On the FDR unit indication is available of the number of recording hours remaining on the tape installed in the unit. Also under-water Locator Beacon is installed on the FDR Unit.

The FDR is maintained as per approved Maintenance Schedule.

Cockpit Voice Recorder:

Cockpit Voice Recorder (CVR) Sl.No. 6519 Model A100 manufactured by Fairchild was installed on this aircraft. The CVR is installed on the R.H. side of the airplane in aft cargo compartment. The CVR control panel is installed on pilot's overhead panel P-5.

The magnetic tape installed in CVR is endless. It records true communication and preserves such records for the last 30 minutes, system continues and records conversation from 4 different channels. The arrangement of 4 channels is as follows -

Channel-1 - First Observer.
Channel-2 - For Co-pilot's station.
Channel-3 - For Pilot's station.
Channel-4 - For Area Mike.

The audio from pilot's station boxes selected from any of the aircraft radio station is recorded in pilot's channel. Simultaneously audio selected by copilot, is recorded in Channel-2. Area mike records conversation in the cockpit and other sounds in the cockpit.

Operating electrical power for voice recorder system is 115V 400 Hz AC obtained through voice recorder circuit breaker on P-6. CVR starts functioning when 115V AC power is available in the CVR. Audible and visual indication derived from the monitoring circuit are presented at a meter and jack when test check on the control panel is operated. Bulk erase facilities of the CVR is not available. The unit is fitted with under-water Locator Beacon.

4A. MATERIAL DETAILS OF AIRCRAFT VT-EFL :

Aircraft :

This aircraft was delivered to Indian Airlines on 3.12.1977. The initial Certificate of Airworthiness was issued on 5.9.1977. The Certificate of Airworthiness was last renewed on 26.11.1990 and was valid upto 27.11.1991. This aircraft was maintained as per approved Maintenance Schedules. All Mandatory Modifications and Inspections stipulated by the DGCA have been complied with on this aircraft.

(1)	Total hrs./cycle flown	:	29,729:50 hrs./33574 since new
(2)	Last major inspection (Check-II Pt.B)	:	July 1990 - 27945:00/31585 landings.
(3)	Last Check-I	:	20.6.1991 - 29305:05/33150 landings.
(4)	Last Flight Release Inspection	:	20.6.91 carried out at 29305:05 hrs. valid upto 29805:05 hrs./28.8.91 whichever falls due earlier.
(5)	Hours flown since last flight release	:	424:45 hrs.
(6)	Pre-flight Inspection	:	Carried out on 16.8.1991 before first flight from Calcutta.
(7)	Take off weight of the aircraft.	:	44,602 Kg.
(8)	Centre of gravity on take-off	:	21.8% MAC

The aircraft take off weight and centre of gravity during this flight were within the permissible limit.

This aircraft was involved in one notifiable accident wherein one person was hit by the aircraft on the landing run while operating flight IC-117 on 12.1.1978 at Hyderabad.

Engines:

The Boeing 737 VT-EFL aircraft was powered by two P&W JT8D-17A engines developing maximum thrust of 16,000 lbs. each. The particulars of the engines fitted on the aircraft are given below:

(a). Left Hand Engine Sr.No.	:	P688451B.
Hours/Cycles done since new	:	22180:25 hrs., 25234 cycles.
Hrs./Cycles done since last overhaul	:	7151:00 hrs. 8090 cycles
Hrs./Cycles done since installation on VT-EFL	:	106.50 hrs. 104 cycles
(b). Right Hand Engine Sr. No.	:	P702748B.
Hrs./Cycles done since new	:	17227:05 hrs. 20923 cycles
Hrs./Cycles done since last overhaul	:	9464:20 hrs. 11246 cycles
Hrs./Cycles done since installation on VT-EFL	:	884:05 hrs. 911 cycles.

Flight Data Recorder :

Lockheed Flight Data Recorder Serial No. 555 was installed on the aircraft. The unit was last overhauled on 23.1.89 and was also calibrated. This FDR was installed on VT-EFL on 4.8.1991 and hours done after installation is 87:40 hours and total hours done since last overhaul is 2402:35 hours (overhaul life 4500 hours).

Cockpit Voice Recorder :

Cockpit Voice Recorder Serial No. 6519 was installed on the aircraft. The unit has done 5482 hours since last overhaul and 125:40 hours since last bench check (overhaul life is 6000 hours and bench check is required to be carried out at 1500 hours).

4B. UTILISATION OF NAVIGATION AND COMMUNICATION AIDS :

Navigational information is derived from the following systems :-

(a) ADF System - There are two ADF systems on this aircraft. ADF-1 and 2 are identical except for the pointer. No.1 ADF is connected to single bar pointer and No.2 system is connected to double bar pointer in RMI on Pilot and Co-pilot's side. Control boxes are located on the pedestal. The ADF when tuned to a particular station gives bearing of that station which is read on the RMI.

(b) VOR System - There are two VOR systems on this aircraft. Two VOR Nav. Receivers of No.1 and 2 systems are located in the Electric and Electronic (E&E) compartment. The VOR indications are available on RMI one on each side. These RMI are common for ADF also with the transfer possible with selector. The VOR information is also available on the Course Deviation Indicator (CDI) one on each side. The VOR station frequency is selected in the control box & audio can be monitored either from pilot or copilot station.

(c) Instrument Landing System (ILS) of B737 aircraft - VHF/NAV. receiver No.1 used for VOR No.1, is same for Localizer No.1. Similarly Nav. Receiver No. 2 is common to Localizer No.2. The Localizer frequency is selected in the control boxes of No.1 and 2.

Glide Slope signal is also processed in the same VHF Nav. Receiver unit. Thus Nav. Receivers (Systems No.1 & 2) process signals for VOR, Localizer, and Glide Slope. If Localizer frequency is selected in No.1 control box and when signal strength is sufficient enough, the flag of pilot's side CDI will disappear and the vertical bar will deflect 'OFF' centre depending upon the position with respect to the

centre line of the runway, vertical bar will be at the centre. In FDI (Flight Director Indicator) Runway Symbol also moves laterally against an index mark according to position of aircraft with reference to the centre line of the runway.

When the ILS frequency is selected either on No.1 or No.2 control boxes, the Glide Slope receivers will be automatically 'ON' (paired frequency) and with the capture of glide path beam the flag on FDI and CDI (on both pilot and copilot side) will disappear. The horizontal pointer (both on pilot and copilot side) will deflect off the centre. Pilot follows the bar and pointer to align the aircraft to the centre line of the runway and glide path. If either the ground equipment or the aircraft equipment is faulty the flag will appear on the CDI (Course Director Indicator) and FDI (Flight Director Indicator).

The Marker Beacon Receiver (one only) is installed in the E&E compartment. There are two sets of Marker light indicators consisting of three lights on each side installed on pilot and copilot's instrument panel. 'Blue' light is for Outer Marker, 'Amber' for Middle Marker; when the aircraft passes over the Markers, lights will illuminate on both pilot and copilot's side. Simultaneously audio signals will be heard in loud speaker/Head set.

(d) Weather Radar :- A weather radar system consisting of an antenna, transreceiver, control module, and Plan Position Indicator (PPI) is installed on the airplane. The received signals are converted to a visual picture on the PPI. The PPI presentation, of ground and weather returns enables the pilot to navigate utilizing ground returns, or to detect weather and make a decision to penetrate or circumnavigate the storm cells.

(e) Low Range Radio Altimeter (LRRA) :- Two low range radio altimeters provide signals to the autopilot, flight director computers and MDA light. Two indicators, one on each pilot's panel, read absolute altitude.

(f) Distance Measuring Equipment (DME) :- The DME receiver provides the necessary signals to the DME computer, which converts the signals to read range to the station.

(g) Ground Proximity Warning System (GPWS) : Ground Proximity Warning System (GPWS) provides the pilot with aural and visual warning of potential dangers of flight path related to the ground. GPWS processes radio altitude information from No.1 low range radio altimeter (LRRA), altitude rate information from Central Air Data Computer (CADC), Glide Slope deviation information is derived from VOR/ILS system and landing gear and landing flap position signal to provide warning of the following -

1. Excessive rate of descent.
2. Excessive terrain closure rate.
3. Altitude loss after take off.
4. Unsafe terrain clearance.
5. Excessive deviation below glide slope.

Note :- The GPWS will not provide a warning if an airplane is flying directly towards a vertical cliff.

GPWS consists of ground proximity computer, two warning lights labelled 'PULL UP', a warning speaker, two glide slope warning indicators with inhibit facilities labelled 'BELOW G/S'.

The red warning light labelled 'PULL UP' is installed on each pilots instrument panel which comes 'ON' to provide visual indication. GPWS generates warning of the unsafe flight path.

Rectangular shape amber Glide Slope advisory light labelled 'BELOW G/S'. is installed on each pilots instrument panel. G/S warning light when pressed inhibits the G/S deviation working. The warning speaker provides an aural warning of the unsafe flight path.

4C. MAINTENANCE RECORDS :

Scrutiny of the maintenance records of the aircraft reveal the following :-

(a) No Mandatory Modifications/Inspections were outstanding at the time of the accident.

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

(c) Repetitive defects of last 3 months pertaining to Communication, Aircraft Controls, Radio Navigation Systems and Engines were scrutinised. It was observed that -

(i) Flaps not extending to 40 position/getting stuck up between 30-40 units repeated between 22.5.91 to 4.6.91 (13 days). This was finally rectified on 4.6.91 by replacement of screw jack assemblies 1 & 8 which were found worn.

(ii) On Radio Navigation System "Weather Radar unreliable" repeated between 5.8.91 and 9.8.91. It was finally rectified by replacement of radar Tx.Rx.

(iii) No. 1 engine N2 fluctuation snag repeated between 21.7.91 to 29.7.91. This was finally rectified by replacement of N2 Tacho Generator. It may be mentioned that on 24.7.91 also N2 Tacho Generator was replaced.

(iv) Oil temperature fluctuation snag on No.2 engine repeated between 4.7.91 and 14.7.91. It was finally rectified by replacement of oil temperature bulb.

(d) Further, while scrutinising the defects of last six months on engine of this aircraft following were observed :-

(i) On 6.4.91 EGT gauge fluctuation between 300 to 450°C. This was rectified by cleaning the EGT gauge plug.

(ii) No.2 engine all parameters shooting up while starting on 10.4.91. This was rectified by replacement of Fuel Control Unit (FCU).

(iii) R.H. engine cowl valve light 'comes ON and OFF' on 23.4.91. Engine cowl valve was replaced.

(iv) No.1 EPR gauge sluggish during change of power on 21.6.91. No.1 EPR transmitter was replaced.

(v) On 14.7.91 No.2 engine start up was slow. No.2 engine N1 indicator replaced and No.2 bleed valve clamp tightened.

(vi) On 7.8.91 No light up during No.1 engine starting, Igniter box replaced.

(e) Engine Trend Monitoring :

The Engine Trend Monitoring System for P&WJT8D-17A engines comprises monitoring of following parameters-

EGT, N1, N2 and Fuel Flow.

With regard to EGT, the shift was +5°C for both engines against the limit of 20°C. Also for N1 the shift was 0% against the limit of 1.7%. Regarding N2, it was 0% for No.1 engine and 0.4% for No.2 engine against the limit of 1.3% and for fuel flow the deviation was 0% for No.1 engine and 2% for No.2 engine against the limit of 5%.

The above trend monitoring covers the period from 3.8.1991 to 12.8.1991 for No.1 engine and 23.5.1991 to 12.8.1991 for No.2 engine.

In view of above, the trend monitoring data reveal that engine performance during the above period showed no abnormality.

(f) Check-B Schedule :

Check-B was carried out on this aircraft on the night of 15/16.8.1991. During this inspection, Electrical AME carried forward the APU generator defect as per MEL as suitable spares were not available. The snag pertains to APU generator not coming on line, recorded after the operation of Service No.IC-277 of 15.8.91.

Airframe AME who carried out Check-B Schedule attended two minor defects - (i) forward attendant seat not secured; (ii) aft toilet flushing cable was snapped.

For (i) temporary repair was carried out and the snag was carried forward for necessary permanent repair. With regard to (ii) toilet servicing was done at Calcutta. This snag was further carried forward due to non-availability of spares.

5 FDR : CVR READ-OUTS:

The report of the Inspector of Accidents as also the evidence on record disclosed that the Lockheed Flight Data Recorder (Sl.No.555) was retrieved though in a slightly damaged condition at its rear portion and a missing front main seal from the crash site but the engravings on the aluminium foil were otherwise readable so as to appreciate the necessary flight path and other incidental details in regard to the entire flight from Calcutta to Imphal. It is true that the static connector on front face was found broken and the pitot mating connector of the aircraft had sheared off from tubing but the recorder could be opened as per the statement of Shri Satendra Singh, Director Air Safety at DGCA Headquarters without any difficulty.

The Flight Data Recorder of the ill-fated flight was decoded and subsequently reviewed in my presence at the Technical Centre, DGCA Headquarters, New Delhi as also in the presence of the assessors appointed by the Central Government. It was viewed on the Nikon Profile Projector and all the engravings on the aluminium foil could be clearly seen. Incidentally it is to be noted that this particular Lockheed Flight Data Recorder has basically only five different parameters, namely, (i) Altitude; (ii) Heading; (iii) Airspeed; (iv) Vertical Acceleration; (v) Time. This particular FDR seems to be a very old type of FDR since all modern aircraft have fitted with a Digital Flight Data Recorder having around 300 several parameters - obviously making the investigation of any air crash easier, precise and exhaustive. The lack of other parameters creates some sort of inconvenience and difficulties in the matter of investigation though, however, it cannot be said to be of an impossibility since the difficulties are not insurmountable in nature. It is always better to avail of the latest scientific achievement rather than depending upon an obsolete method in order to arrive at a correct finding.

Incidentally, however, it is to be noted that out of the five parameters available on an FDR of the like nature, this particular FDR however recorded only four during the entire course of flight and the vertical acceleration parameter was available only for short interval during the take off phase from Calcutta. Therefore, this particular parameter, namely, the vertical acceleration for all practical purposes is not available to this Court of Inquiry for the Inquiry. The non-availability of this particular parameter may be due to two reasons (i) The recording stylus of the unit got adrift as a result it was well neigh impossible to have the engravings on the aluminium foil and (ii) Loss of vertical acceleration data signal due to mal-functioning of some systems. It is to be noted, however, in the event of the happening as at (ii) above, it will however, leave a straight line engraving on the aluminium foil which was, however, not seen on the foil. In the absence of which one can safely conclude that there was no mal-functioning of any system of the FDR unit but the stylus recording the vertical acceleration got adrift immediately after the take off from Calcutta Airport. This deficiency of the stylus getting adrift cannot, however, by any stretch be said to be a mal-functioning of a unit neither it can be ascribed to be a defective FDR unit at the time of commencement of journey from Calcutta.

This Court of Inquiry thus is slightly handicapped by reason of non-availability of the vertical acceleration of the aircraft.

The decoding of the FDR foil was taken using a lens of 50 X magnification and the values of the parameters obtained were checked for their validity and found to be accurate. The details of the parameters would appear from a schedule Annexed hereto and marked with letter "C".

Cockpit Voice Recorder:

On the available evidence it appears that this particular aircraft VT-EFL was fitted with a (Fairchild Cockpit Voice Recorder

Serial No.6519) and was recovered from the crash site though after some efforts. The evidence further disclosed that the dust cover had to be cut for the purpose of opening out this recorder and all the electronic cards in the rear portion were found severely damaged due to the impact. The stainless steel crash proof casing was taken out by cutting the inner casing of the CVR. The stainless steel box could be opened, however, without any difficulty and the megnetic tape was found intact. After slight adjustment, the tape could be played and it was noticed that all the recordings were available. The transcription was prepared at the Technical Centre, DGCA Headquarters, New Delhi by Shri V.K. Chandna, Capt. S.S. Panesar and Shri L.N. Lal all belonging to the DGCA Headquarters, New Delhi, and holding responsible positions. The tape transcript was heard by me along with the assessors and copy thereof was made over to all the parties. To be definite about the correctness of the transcription, I directed that the tape be replayed in the presence of all the parties, but since some confusion arose during the course of hearing, there was a further re-checking at the DGCA Headquarters at New Delhi in the presence of the ICPA officials as it was stated that the colleagues of the pilots operating the ill-fated flight could be in a better position to identify the voices and the exact transmission. It is to be recorded, however, that slight modification of the transcript was affected after having the tape played for a number of occasions. It will not also be out of place to mention that during one of the Court hearings Shri K.B. Roy Choudhury being the father of Capt. D.B. Roy Choudhury, the Co-pilot of the ill-fated aircraft was also requested to identify the voice of his son - whereas one of the transmissions could be identified, but some difficulties was experienced by him in regard to the identification of other transmissions and hence the second exercise as above had to be undergone in order to obviate any doubt in the matter of correctness of the transcription. Extracts of the CVR recordings have already been noted above.

5.1 FDR AND CVR CO-RELATION:

At this stage, however, it would be convenient to note the co-relation between the FDR readings and the CVR transcript for the purpose of ascertainment of the correctness of the call-outs from the aircraft. This in the normal course of events may not be of any consequence since the FDR reading should match with the corresponding tape transcript but in this particular unfortunate incident it appears that there are certain major discrepancies between the call-outs and the FDR data.

TIME (hr:min:scc)	FROM	TEXT	FDR DATA	
			ALTI. TUDE	HEAD ING
06:48:28	IC-257	Dhaka India 257 approaching ching overhead Charlee Mike Lima level 290 changing over.	28933	53.5
06:48:42	IC-257	Agartala India 257 over Charlee Mike Lima.	28933	53.7
06:48:47	Agartala	257 Roger report passing Alpha Alpha Tango.	28933	53.7
06:51:44	IC-257	Roger India 257 approaching overhead Alpha Alpha Tabgo.	28933	53.4
06:52:15	IC-257	Calcutta to Imphal departed Calcutta 0624 maintaining level 290. Estimating your field at time 0708. Imphal 0724.	28933	53.6
06:54:22	IC-257	Maintaining level 290 from Calcutta to your field departure from Calcutta was at time 0624 estimating abeam Kumbhigram at time 0708 overhead	28933	53.4

TIME (hr:min:sec)	FROM	TEXT	FDR DATA ALTI. TUDE	HEAD ING
		your field at 0716. Will you go ahead with latest weather aircraft is Echo Foxtrat Lima and transit figure is 31.		
06:58:34	IC-257	Imphal India 257 negative traffic with Silchar descent from level 290.	28503	53.6
06:58:51	Imphal	Victor 257 Roger descent to flight level 135 report reaching.	28363	53.8
06:59:33	IC-257	Imphal 257 descending to 135.	27300	58.1
07:05:00	IC-257	And level approaching one three five further descent.	15045	89.6
07:05:04	Imphal	Roger descent to flight level 115 transition level.	14776	90.1
07:09:45	IC-257	Now we are one two miles inbound at ten thousand 1009.	10162	69
07:11:29	IC-257	We are approaching overhead.	10174	65.5
07:11:32	Imphal	Understand you are proceeding on a radial 217 for ILS.	10180	65.4
07:11:36	IC-257	That is affirmative.	10183	65.3
07:12:13	IC-257	257 on the outbound leg for the let down and descending to 5,000.	10039	93.0
07:14:01	IC-257	We are now 6500.	7738	209
07:14:39	Imphal	India 257 request altitude passing.	6880	210

TIME (hr:min:sec)	FROM	TEXT	FDR DATA	
			ALTI. TUDE	HEAD ING
07:14:42	IC-257	5,000, 5,900 feet.	6868	208
07:14:48	Imphal	Give a call commencing procedure turn.	6826	198.4
07:14:50	IC-257	We are in the procedure turn, we will call you inbound.	6775	196.0

From the above co-relation, it appears that IC-257 after reporting approaching overhead Charlie Mike Lima and level 290 changed the heading from 076° to 053° instead of 007° as per the flight plan provided by the operator, in this case, the Indian Airlines. Subsequent transmission at 06:51:44 from the aircraft to Agartala Tower to the effect 'Roger India 257 approaching overhead Alpha Alpha Tango' cannot be said to be a correct transmission by reason of the heading, namely, 053 as noted above. On the heading of 053 the aircraft could not possibly have gone overhead Alpha Alpha Tango. This, therefore, seems to be a wrong call-out and according to Capt. Mehta, the then Operations Manager of Indian Airlines at Calcutta, the aircraft was nowhere near Agartala overhead and it was a wrong reporting. Capt. Mehta also agreed that this wrong reporting cannot but be ascribed to be lack of discipline so far as the pilot was concerned (Capt. Mehta Q. 238 - 241). In this context the evidence of Capt. Rahut is of some significance: At first there was an attempt on the part of Capt. Rahut to avoid answering the question directly as to the factum of the aircraft being overhead Alpha Alpha Tango by saying that it would be otherwise impossible to be overhead Alpha Alpha Tango since the obtuse angle cannot be availed of by the aircraft and hence there is a likelihood of violating the Bangladesh air-space. (Capt. Rahut Q.19) Subsequently, however, on a pointed question that he being an experienced flyer, does he also avoid the flight plan with a heading of 007 and cut short overhead Agartala by taking 053 direct route to Imphal and the answer of Capt. Rahut in no uncer-

tain terms suggest that he being an experienced flyer would invariably report overhead Alpha Alpha Tango and there should be no problem in regard thereto (vide Q. 239). Shortly thereafter, however, Capt. Rahut has also stated that even though the other pilot may not be as experienced as him, he should be able to negotiate the turn from a heading of 007 without any difficulty (vide Q. 248 - 249). Incidentally, it is to be noted that the flight plan itself provides that after reporting VGCM i.e. Comilla with a heading of 073° the aircraft is supposed to proceed at a heading of 007 and should report overhead VEAT i.e. Alpha Alpha Tango (Agartala). This flight chart has been prepared by the operator itself and there is ample evidence on record that the chart should be adhered to in its observance rather than in its deviations. Flight charts are prepared having due consideration of all the relevant and necessary particulars with one object in mind namely the safety of the aircraft and when the flight chart specifically provides for reporting overhead VEAT that should imply that this route prescribed is otherwise safe and in accordance with law without any violation of any foreign air-space. As such Capt. Rahut's evidence in regard to violation of Bangladesh air-space cannot in my view be accepted and properly appreciated. Obviously Capt. Rahut's evidence in regard thereto namely the violation of Bangladesh air-space was under misconception of the entire situation to say the least about it. On the subject, still, the evidence of Capt. M.V.V. Rao also ought to be noted - unfortunately, with Capt. Rao also there was an attempt to avoid the issue in regard to the adherence of the flight chart as prepared by the operator - Capt. Rao has stated that as a matter of fact in the normal circumstances though there ought not to be any deviation from the chart but deviations can be had in regard to the altitude. I have not been able to follow this particular evidence of Capt. Rao. Flight charts as noted above are to be observed. Question of deviation therefrom does not and cannot arise. This laxity ought not to be allowed otherwise the sanctity of the flight chart is completely obliterated. I should have thought that the head of the training institute of the operator should be more fair and frank in regard to the failure if any on the

part of the pilot to follow the flight chart. But unfortunately, there was an attempt to avoid answering the question in a fashion as is expected of a trainer. There cannot be any manner of doubt that under certain exceptional circumstances one may deviate from the flight chart with the permission of the ATCO, but that can only be termed to be an exception rather than a regular feature which in this case as detailed more fully below has happened. I was surprised that, the evidence of Capt. Rao when he stated before this Court that as a matter of fact on a plain reading of the CVR he was extremely happy as to how a pilot has conducted himself during the course of flight even though he had the FDR reading with him which negates such an appreciation. The training master ought not to be quite content with what he has done apparently but he must go deep into the matter - compare the actual with the CVR transcript and see for himself whether in fact he has followed the procedure or not. There ought not to be a sense of complacency in a trainer that my pupil has done everything correctly. On the contrary, the first attempt should be to make out as to whether there is any failure on his part so that the lives of the passengers are not in any way put into any jeopardy. Human lives are precious. It ought not to be lost by the whim or caprice of a particular individual and this ought to be the subjective training to be imparted on to the trainee. In this context, reference can be had to Q. No.344 - 347. On a pointed question, however, Capt. Rao had to eventually admit that if he was doing the route check and if the pilot-in-command was following the same pattern he will not pass the pilot-in-command to get his command licence (vide Q. No.349).

It is pertinent to point out, however, that Capt. Mehta the erstwhile Operations Manager of Indian Airlines has been extremely fair and this Court records its appreciation on this score.

Coming back once again on to the co-relation of the FDR chart and CVR transcript, it appears that at 07:14:01 the aircraft categorically made a transmission to the effect "We are now 6500", but in fact, from the FDR it is apparent that the aircraft was at a

height of 7600 feet and not at 6500 feet. This transmission also goes to show an incorrect call-out being given by the aircraft. Capt. Mehta in no uncertain terms admitted that the call-out is wrong since there is difference of about 1,000 feet. Similar is the transmission at 07:14:42 wherein the altitude call-out has been to the effect 5000; 5900 and on a question from ATCO as to confirmation of 5000 the call-out from the aircraft was "affirmative". But in fact, the aircraft was about 6880 feet - why this wrong call-out, can it be that the Altimeter at the front panel have gone wrong, this possibility according to me prior to the evidence could not be ruled out, but Capt. Mehta in no uncertain terms stated that it is a wrong call-out and the possibility of the Altimeter going wrong does not and cannot arise. Capt. Mehta stated with conviction that there are two Altimeters and two systems are independent and both the systems cannot go wrong simultaneously (vide Q. 421). I accept the evidence of Capt. Mehta on this score that no snag can be said to have occurred so as to render both the Altimeters unserviceable during the course of flight. This factum of acceptance of Capt. Mehta's evidence is based on subsequent scrutiny of the FDR reading and the call-out when both the recordings did in fact match with each other : To wit,

i) At 06:48:28 aircraft transmitted Flight Level 290 and corresponding FDR data shows 28933 feet.

ii) At 06:52:15 the aircraft reported maintaining level 290 FDR recorded 28933 feet. Same is the position at 06:54:22

iii) At 06:58:34 aircraft transmitted descending from level 290 and FDR shows steady descent from 28933 feet.

iv) At 07:05:00 aircraft transmitted approaching 135, FDR shows at 07:05:08 14610 feet and continues to descend.

v) At 07:09:45 aircraft communicated altitude at 10,000 and FDR also records 10,000.

vi) Finally, the aircraft crashed at 5209 feet as per FDR, which in fact, has been the correct altitude at the crash point.

It, therefore, appears that there was no snag so far as the Altimeters are concerned, rather the discrepancies can be stated to be by reason of wrong call-outs. The other observations in regard to the flight path and the adherence to the let down chart and the timing therefor as appears from the co-relation of the FDR and CVR recordings will appear under the heading "Flight Path followed by the ill-fated Aircraft" as more fully detailed hereinafter in this report. For convenience sake, however, the flight data plot as appears from the FDR and the corresponding transmissions co-related on the plot would appear from a schedule annexed hereto and marked with letter 'D'.

6. FLIGHT CREW INFORMATION

a) Capt.Sekhar Halder, Commander :

Capt. Sekhar Haldar was born on 10 November 1953. He was issued with ALTP Licence No. 1415 on 11.3.1988. He was appointed by Indian Airlines on 22 May 1985 and was deputed to C.T.E., Hyderabad for initial training and subsequent training on Boeing 737 aircraft.

His total flying experience was 3783 hrs. out of which flying experience on Boeing 737 aircraft was 2369 hrs. and 1414 hrs in other types of aircraft including F-27 aircraft.

After having flown on Boeing 737 as Co-Pilot, he was given pilot-in-command endorsement on 27.11.1989 and was having flying experience as PIC on Boeing 737 for 1115 hrs. The details of his recent flying experience are given below -

Experience in last 6 months	:	254:55 hrs.
Experience in last 30 days	:	62:35 hrs.
Experience in last 7 days	:	18:35 hrs.
Experience in last 24 hrs.	:	1:50 hrs.

His last medical check was done on 29 July 1991. Date of last Instrument Rating Check was 10.5.1991 and valid upto 9.5. .1992. Date of last licence renewal was 10.5.1991 and valid upto 9.11.1991. Date of last Route Check was 14.5.1991 and valid upto 13.11.1991. FRTO Licence No. 2742 was valid upto 21.1.1992.

Capt. Sekhar Haldar was based at Calcutta.

(b) Capt. D.B.Roy Choudhury, Co-Pilot

Capt. D.B.Roy Choudhury was born on 30 September 1964. He was issued with CPL licence No. 1592 valid upto 1.9.1991 by DGCA. He was appointed by Indian Airlines on 24 February 1989

and was deputed to C.T.E.,Hyderabad for training. After endorsement on Boeing 737 he was cleared as Co-pilot (P2) on the type. He has got following flying experience :-

Total flying experience	:	1647 hrs.
Total experience on B737 as P2	:	1397 hrs.
Total experience in last 6 months	:	298:20 hrs.
Total experience in last 30 days	:	51:25 hrs.
Total experience in last 7 days	:	11:30 hrs.
Total experience in last 24 hrs.	:	1:50 hrs.

His last Route Check was done on 5.5.1991 and valid upto 4.11.1991. Last Instrument Rating Check was done on 21.11.1990 and valid upto 20.11.1991. Last licence renewal was 8.6.1991 and valid upto 20.11.1991. FRTO Licence No. 3077 valid upto 1.9.1991. He was required to wear corrective glasses.

Capt. D.B. Roy Choudhury was based at Calcutta.

It is to be noted that both Capt. Haldar and Capt. Roy Choudhury have had the required pre-flight medical examination for alcohol and was cleared without any remarks by the concerned Doctor with a certification "N.A.D" i.e. 'No Abnormality Detected'. It is to be noted, however, that there is no clinical examination as such but the check is in regard to pre-flight alcohol test. The proforma for such a certification also contains a column to that effect. The remark 'No abnormality detected' (NAD) in my view cannot be termed to be a sufficient certification more so when in fact there exists a breath analyser equipment at the Calcutta airport. Question of there being an abnormality in a pilot when he is to report for duty does not and cannot arise. The test is not for the purpose of detection of any abnormality but for an alcohol check so as to assure that the pilot has the necessary mental equilibrium during the flight. The certification, therefore, ought to be in consonance with the object for which such a test is asked to be had before the flight.

It is also noted at this juncture, however, that Wg.Cdr. Gupta, Asstt. Director Medical Services(Air) of DGCA has examined the report of the samples of tissues collected from the bodies of the pilot and co-pilot along with the cabin crew and also scrutinised above medical reports of both the pilots and upon such scrutiny came to a definite finding that both the pilots have been medically fit through their flying career and there is nothing to indicate presence of alcohol at the time of the accident.

7. **METEOROLOGICAL INFORMATION**

The ill-fated aircraft IC-257 took off from Calcutta Airport at 0624 UTC(1154 IST). In accordance with the usual practice the pre-flight briefing did take place at Flight Despatch of the operator at Calcutta Airport including weather condition at Imphal prevailing at 0430 UTC (1000 IST). The briefed weather as per the Flight Briefing is to the following effect :-

VEIM 0430; 230/06 Kts; Vis 2000M RA; 4/8 800; 4/8 1800; 6/8 9000 ft; 1/8 CB 25000 ft.; T 21; DP 20; 1008; TS overhead.

Pre-flight briefing also records weather at 0500 UTC as also 0530 UTC to the following effect :-

VEIM 0500: 270/03 kts: 6 Km: RA: 3/8 1500 ft: 4/8 1800: 6/8 10000: T 27; DP 22; 1009 HP.

VEIM 0530: wind calm: 8 km: 3/8 1000 ft: 4/8 1800: 6/8 10000: T 23: DP 22: 1009 HP.

Incidentally it is to be noted that the alternate aerodrome of the flight being Guwahati (VEGT) and the weather for VEGT was also included in the pre-flight briefing.

The aircraft also obtained the Calcutta meteorological conditions at the time of take off and the Tower cleared the aircraft for take off with surface wind calm.

The ill-fated aircraft came in contact with Imphal ATC at 0653.42 UTC and shortly thereafter Imphal weather was given to the following effect :- wind 270/03 kts; vis. 7 km; cloud 3/8 800; 5/8 1800; 8/8 10000; T 26; DP 24; QNH 29.80;

Incidentally it is to be noted that the weather passed was of 0630 UTC. Detailed weather report of 16th August 1991 at differ-

ent points of time would appear from a Schedule annexed hereto and marked with letter 'E'.

It is to be noted in the context of the crash taking place at 0716 UTC, the Tower ought to have transmitted even in the normal circumstances the weather conditions at Imphal shortly after 0700 UTC, more so when the Meteorological Office as a matter of fact has made available the 0700 weather conditions to the Tower being inclement having 1/8 CB to the following effect:-

"290/04 kts; vis 7 Km; 3/8 800 (240M); 5/8 1800 ft.; 1/8 CB 3000ft(900M); 8/8 10000 ft.(3000M) T 26; DP 23 QNH 1009 HPA; 29.80 INS QFE 919 HPA 27.14 INS; CB NE".

This weather, however, was above the operator's weather minima for an ILS approach at Imphal.

It is pertinent to note here, however, that 0430 UTC meteorological report as was available with the Flight Despatch of the operator, categorically recorded that the CB was existing over Imphal airport. Subsequent meteorological report at 0700 UTC however, records the movement of CB in the north-easterly direction and as such it can safely be concluded that the existence of CB would not in any way affect the flight path of the aircraft as per the flight plan which is from the South-West direction. In the premises the affectation of the flight path by reason of existence of CB does not and cannot arise. In any event, however, the ATCO in my view ought to have transmitted the weather conditions immediately on receipt of the same from the Meteorological office irrespective of the fact that the same would not affect the flight path of the aircraft. It is the duty and an obligation on the part of the ATCO to intimate all necessary informations to the pilots and non-communication cannot but be termed to be a lapse on the part of the ATCO though, however, it has no material bearing into the cause of the crash.

The CVR transcript, however, at 07:16:04 UTC records a transmission from the Tower to the aircraft that the rain was approaching from the East and part of the airfield was under rain. The factum of such communication has also been noted by the aircraft.

During the course of hearing, strenuous submissions have been made by the operator mainly as also the Indian Commercial Pilots' Association in regard to the existence of very severe upper wind. The upper wind data, however, as obtained from the Meteorological Office negates such a contention. The record shows for the month of August, 1991 an upper wind in the region of 2 to 12 knots at 5,000 feet level and between 1 to 8 knots at 10,000 feet level. The Meteorological Office in no uncertain terms stated that this wind-measurement was effected by putting up balloons and the measurements were taken with a theodolite equipment. As regards the upper wind data for 16th August, 1991, it has been stated to be at 03 knots at 5,000 feet level at about 12:30 hrs. So far as 10,000 feet level is concerned, no data is available, but considering the ground wind being at 4 knots at that time and 3 knots at 5,000 feet level it cannot vary to an enormous extent and it is obviously in the region of less than 10 knots - though, however, it is a presumption only.

Considering the above, in my view, however, that the upper wind cannot possibly render any significant change in the flight path of the aircraft during the let down procedure. In this context the evidence of Mr. James Kerrigan, being an Aeronautical Engineer of the Boeing Company, Seattle Washington, ought to be noted. Mr. Kerrigan has categorically stated that in spite of a variable wind between 5 to 20 knots, there shall not be much of a difference in the flight path of the aircraft. Mr. Kerrigan has had simulator exercises on the basis of this variable wind and produced the graph before the Court which as a matter of fact corroborates the statement as above. For convenience sake, the graph produced by Mr. Kerrigan is annexed hereto and marked with letter 'F'.

8. **AERODROME INFORMATION** :

The coordinates of the Imphal aerodrome are 24° 45' 49" North, 93° 54' 11" East. It's general elevation is 2536 feet but the elevation of runway 04 is 2532 feet above mean sea level. It has one runway 04/22, and the runway 04 is, however, equipped with Instrument Landing System (ILS). This runway 04 was intended for landing and has the following declared distances :-

(a) Take off run available is 9010 feet.
(b) Take off distance available is 10378 feet.
(c) Landing distance available is 9010 feet.
(d) Accelerate stop distance available is 9210 feet.
(e) Runway 04 has cement concrete surface and Pavement Classification Number (PCN) is 28.

Unfortunately, this particular airport does not have any recording devices so far as the transmission from the ground as also from the aircraft are concerned. On the factual score a very sorry state of affairs appears to be existing even this day. One ATC multi-channel tape recorder supplied by Stencil Hoffman of USA was received at the Imphal Airport in early 1983. For a period of four years no step whatsoever has been taken to have the seven channel ATC tape-recorder commissioned. As a matter of fact as appears from the letter dated 10th September, 1991 from National Airports Authority to the Director General of Civil Aviation that the recorder was installed in June 1987 but it could not, however, be commissioned for want of certain vital components. I fail to appreciate as to how a new equipment could not be commissioned for want of certain vital components. The equipment supplied ought to have been checked up by the appropriate authority at the initial stages that some vital parts are missing. Question of importation of further required spares for the purpose of commissioning a new equipment, in my view, does not arise. This is contrary to all norms of a commercial transaction and the supplier ought to have been intimated in regard thereto immediately after the supply. For

four long years nobody seems to have taken any notice of a costly equipment. Admittedly it is a sophisticated electronic unit which cannot possibly be performing well in the event not put to use for a period of four years. Even after the detection that certain other components are required, all concerned seem to be taking things very easily on the plea that DGTD is not giving any required clearance and subsequent queries to the Indian agent as also foreign supplier did not evoke any response - I am, however, not prepared to accept such a justification as has been given to the Director General of Civil Aviation by the National Airports Authority in terms of their letter noted above. When a Governmental agency enters into a commercial transaction with a foreign supplier, it must act in a manner a commercial organisation is supposed to act. The price has been paid and the equipment has been delivered, but no benefit has accrued to anyone - why this attitude - is it because it is a Governmental property - if this be the case, then it is high time that somebody should be told how commercial transactions should be effected and the concerned department should be properly oriented to meet such a situation. In fine I have no other alternative but to record a totally sad state of affairs in regard to the dealings of a Governmental agency. The attitude seems to be totally indifferent which an organisation connected with Civil Aviation cannot afford to have: human lives are involved and the Governmental agency is quite satisfied by simply writing a letter that steps are being taken to improve the whole situation. I record my total dissatisfaction on to the whole situation in so far as this aspect of the matter under investigation is concerned.

The Aeronautical Information Circular (A.I.C.) 14 of 1984 dated 18 September 1984 issued by the Director General of Civil Aviation, R.K.Puram, New Delhi records that the aerodrome is surrounded by a number of hills and the height and direction of different hills have not yet been determined. Subsequently however, upon the formation of the National Airports Authority, this particular airport has been provided with Instrument Landing System (ILS). Though in 1984, the details of obstructions had not

been determined, obviously the National Airports Authority prior to the introduction of the ILS let down procedure have been able to detail out these hills and other obstructions in the area in question. It is to be noted that after preparation of ILS let down chart, the same was sent to the operator, being Indian Airlines, for their comments and the operator duly accepted the same as being otherwise safe. Needless to record here that the operator has been operating on the Instrument Landing System since 1987 at Imphal Airport and at no point of time any objection has been raised by the operator. As a matter of fact, during the course of hearing no submission even has been made by the operator in regard to any deficiency in the Instrument Landing System as per the let down chart at the Imphal Airport. The ICPA (Indian Commercial Pilot's Association) however before this Court of Inquiry raised a doubt as regards to the primary and secondary areas which according to ICPA can not be termed to be safe operational areas as stipulated by ICAO. It is to be noted here, that Shri S.A.Ram, Deputy Director of N.A.A. and incharge of the preparation of the Instrument Let Down Chart, in question, stated that there, in fact, exists a primary and a secondary area and the distance from VOR to the outer limit of the primary area would be about 19 nautical miles and the limit of the secondary area would be an additional 2.5 nautical miles. Shri Ram has stated that secondary area would extend upto 21.5 nautical miles from the VOR. While it is true that the pilots are never given any primary or secondary area chart, but while preparing the let down chart some safety zone shall have to be provided to cater for the error on the part of the pilots so that the same may provide a cushion or a buffer. It is pertinent to note that primary area provides for a clearance of 984 feet above the highest obstruction within the area and if one proceeds thereafter towards the outer boundary of the secondary area, this clearance of 984 feet is progressively reduced to zero at the outer extremity of the secondary area.

From the ILS let down chart it appears that the aircraft after reporting overhead VOR at 10,000 feet should descend to 8,000

feet on the holding pattern itself and then proceed on to the outbound leg for 2 minutes 30 seconds from VOR upon a further descent from 8,000 feet to 5,000 feet at the commencement of the procedure turn with a speed not exceeding 170 nautical miles per hour. The aircraft whilst on the procedure turn is supposed to further reduce its height to 4,200 feet and upon capturing the localiser to proceed inbound. Height of the aircraft shall have to be at 4,020 feet at the outer marker inbound and then land with the assistance of the other landing aids available at the airport. It is significant to note here that the Pilot-in-Command of the aircraft is not aware of any primary or secondary area but a strong adherence to the let down chart is expected from the pilot. It is in evidence that deviation from the let down chart is not permitted in IFR flight. Safety of the aircraft on the basis of the let down chart cannot be doubted in any manner whatsoever. Capt. Rahut in his evidence categorically stated that the let down chart cannot be said to be unsafe from any point of view. Though it is true that the chart is not unsafe by any stretch but that does not, however, mean and imply that the buffer or the cushion though intended at the time of preparation of the let down chart shall not be existing as a practical reality. The primary and the secondary area ought, therefore, to be free of any obstruction or any material obstruction considering the altitude, the aircraft is supposed to be in that area.

In the ILS let down chart it has been shown that there exists an obstruction immediately before the outer marker inbound at a level of 3094 feet above sea level and considering the elevation of the Imphal airport the obstruction height is to the extent of about 600 feet. The ILS let down chart provides the outer marker inbound level at 4,020 feet and considering the ICAO regulation of obstruction free distance being 984 feet the let down chart can not be described to be unsafe in any manner. The importance of obstruction free primary and secondary area however, can not be decried in any way but since a doubt has been expressed in regard to the same it would be better for all concerned to review the entire situation specially pertaining to the North Eastern Region Airports

and also the hilly terrain airports in the country so as to provide the necessary buffer to the aircraft in reality rather than in templates only. I wish to make it quite clear that the let down chart is quite safe and this is also the considered view of my Assessors, one being an experienced flier and other being a reputed engineer. The view as above has also been corroborated by senior officials of the operator as well.

It is to be noted that C.T.E. of Indian Airlines as early as in 1989 did inform N.A.A. that the let down procedure is otherwise satisfactory for normal ILS. Though however, in the meantime they have suggested slight variation of the altitude at the outer marker inbound level from 4,020 to 4,200 feet by reason of activation of G.P.W.S. on account of hill near outer-marker. But no positive objection has been taken in regard thereto. The suggestion is merely on the basis of GPWS system and not otherwise a safety requirement.

Considering, however, the importance and urgency of the situation, this Court directed the DGCA and the National Airports Authority to review the whole situation even during the pendency of this investigation.

For convenience sake the ILS let down chart is detailed hereunder :-

IMPHAL, INDIA

TULIHAL

CAT A, B & C ILS Rwy 04

LOC *110.3 IPH

Apt. Elev 2536'

*TULIHAL [illegible] 123.5

Alt Set hPa

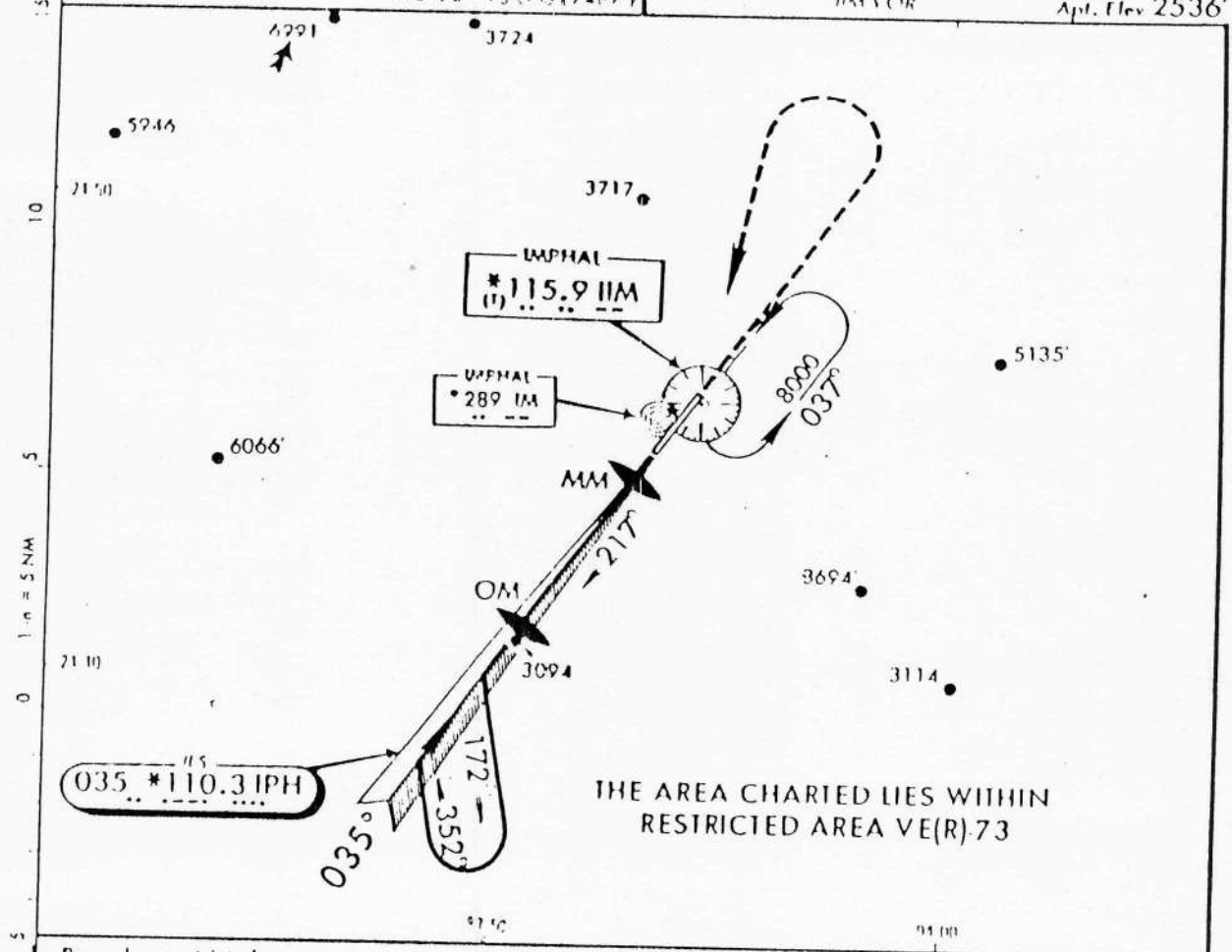
Transition Alt 10,000

Transition Level By ATC

10,000

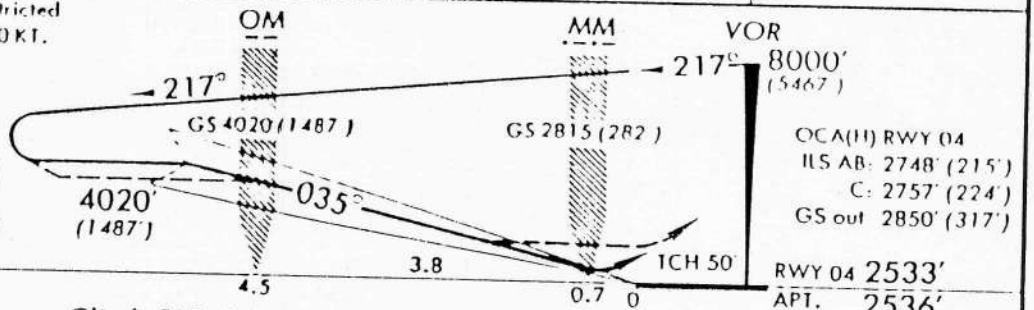
9500

MSA IMM VOR



Procedure restricted to max IAS 170 KT.

Start turn at 2½ Min from VOR 5000'(2467') to 4200'(1667')



OCA(H) RWY 04
ILS AB: 2748' (215')
C: 2757' (224')
GS out 2850' (317')

MISSED APPROACH: Climb STRAIGHT AHEAD to 4200' (1667'), then turn LEFT to join the VOR holding at 8000' (5467').

STRAIGHT-IN LANDING RWY 04			CIRCLE-TO LAND	
ILS		LOC (GS out)		
OCA(H) AB: 2748' (215') C: 2757' (224') FULL	OCA(H) 2783' (250') MM out	MDA(H) 2850' (317') MM out	MDA(H)	
A B C	1200m	1600m	A	3400' (864') 1600m
			B	3400' (864') 2000m
			C	3480' (944') 4400m
D	NOT APPLICABLE		D	NOT APPLICABLE

Grad speed Kts	70	90	100	120	140	160
GS 3.00°	377	484	538	646	753	861
OM to MAP 4.5	3 51	3 00	2 42	2 15	1 56	1 41

Area & Notam

CHANGES: MDA, Procedure & Missed approach altitudes

The ILS let down chart as noted above categorically points out that upon obtaining the glide slope at 4,020 feet, the pilot should follow 035° heading and then land provided, however, the runway is visible at 224 feet above the runway level. In the event, however, the runway is not visible at the height mentioned above, the aircraft is supposed to do a missed approach procedure and climb straight ahead to 4,200 feet and then turn left to join the VOR holding pattern at 8,000 feet. Similar provision has been made in the chart in the event of the glide slope or the middle marker being not available, the aircraft in that event, however, cannot land unless the runway is visible from an height of 317 feet and the aircraft is to carry a missed approach procedure as noted above. The procedure laid down is elaborate and if followed question of the let down chart being unsafe does not and cannot arise.

The distance between VOR and the outer marker is around 6 nautical miles. From outer marker to the farthest point on procedure turn the distance would be around another 5 nautical miles and calculating the total distance, therefore, it comes to around 11 nautical miles from VOR. Obstruction if any admittedly is at 17.3 nautical miles at an altitude of 4,265 feet. There is, therefore, a cushioning area of 6 nautical miles for the aircraft to obtain ILS assistance and land at Imphal Airport presently.

Mr. Ram has stated that at an indicated speed of 170 knots and having taken into account statistical wind of 15 knots together with an additional 10 knots the aircraft can fly otherwise very safely for 166 seconds outbound from VOR. In accordance with the chart, the aircraft is not supposed to fly more than 150 seconds. Therefore, total cushioning flying area is to the extent of 16 seconds, which cannot by any stretch be termed to be low for safe distance. As a matter of fact, this cannot be said to be unsafe at all. Thus, from whichever point of view the chart is looked upon, namely, either from distance-wise or from flying time-wise there is sufficient cushioning even at this stage in so far as the let down chart is concerned.

Turning back on to the evidence tendered before the Court, it is seen that Capt. Rahut himself has submitted that 60 nautical miles tail wind will drift the aircraft forward maximum to the extent of 2.5 miles beyond the farthest point of procedure turn and in the event of farthest point of procedure turn is treated as 11 nautical miles then in that event at best it can come upto 13.5 nautical miles and not beyond that. Assuming a further cushioning zone of 2.5 nautical miles is added thereon, the distance therefore comes upto 16 nautical miles. It, therefore, appears that there ought not to be any difficulty experienced by the pilot even if there exists a tail wind speed of 60 nautical miles provided there is due adherence to the let down procedure. It is, however, placed on record that the tail wind of 60 nautical miles does not have any corroborative documentary evidence since the Meteorological report has recorded maximum upper wind at 5,000 feet as 3 knots on 16th August, 1991. It is however, placed on record that according to the Director Aviation Services, Mr. L.K. Murthy "The estimated 0600 UTC wind on 16.8.1991 at Imphal at 3.1 Kms. is 120/10 kts."

In that view of the matter the question of existence of obstruction in the primary area being the cause of the accident does not arise. The answer to the inquiry namely can this aircraft by reason of 60 nautical miles tail wind drift to the crash site cannot, therefore, but be in the negative.

9. **NAVIGATIONAL AIDS AT IMPHAL AIRPORT** :

The Inspector of Accidents reports that there exists following Navigation and landing facilities at Imphal airport :

"(a) Instrument Landing System (ILS) comprising of Localizer, Glide Path, Middle Marker & Outer Marker.

(b) Very High Frequency Omni-Directional Radio Range (VOR).

(c) Non-Directional Beacon (NDB).

It may be mentioned that no Locator Beacon is installed either at Middle Marker or Outer Marker.

Also no DME is installed with the VOR at this aerodrome. It is understood from National Airports Authority (NAA) that DME equipment was received at Imphal in July, 1991. Its installation is likely to be taken up in early October (1991) and is assessed to be completed towards the end of November 1991. Subsequently, however, the Inspector of Accident reported to this court by way of a letter dated 5th December, 1991, that the DME has already been installed and has become operational on and since 29th November, 1991.

Instrument Landing System:

The Instrument Landing System enables the pilot of an aircraft to make a safe approach and landing on a runway even under adverse weather and visibility condition. The system provides azimuth guidance, elevation guidance and distance from threshold information.

(i) **Function of components of ILS** :

(a) Localizer :

The Localizer provides lateral guidance or azimuth guidance and enables the pilot to align the aircraft with the centre line of the runway. Localizer coverage is provided up to a distance of 25 NM within 10° on either side of extended centre line of the runway and a distance of 17 NM within 35°.

(b) Glide Path :

The Glide Path provides elevation guidance, due to which aircraft is able to descend along pre-determined

path during landing. The normal glide angle is 2° to 4°. It provides coverage upto 10 NM within a sector of 8° in the direction of approach.

(c) Outer & Middle Marker :

The Outer and Middle Markers, located at specified distance from the runway along with the approach path, provide information to the pilot regarding position of the aircraft with reference to runway threshold.

(d) Monitors :

These components of ILS are provided with their associated monitoring remote control and status indication system. Monitoring system keeps under check the performance of the equipment and in case of malfunctioning, switches over to standby equipment. In case, standby equipment also does not perform within specified tolerance the facility is automatically shut down. Remote control and status indicator system facilitates in switching ON/OFF from a remote location as well as to know the status of serviceability of the facilities.

As per ICAO requirement, routine flight checks on ILS should be carried out once in 90± 15 days.

(ii) **Imphal ILS Equipment & Installation** :

ILS system at Imphal comprises of Localizer, Glide Path, Middle and Outer Markers. These facilities were commissioned in February, 1987 and were last flight tested on 5.6.1991 and operational status of all the components of ILS was declared unrestricted.

(a) Localizer :

Localizer G.C.L. 721 was manufactured by Gujrat Communication and Electronics Ltd. The Localizer equipment consist of main and standby channels installed in an equipment room at the airport. The Localizer is installed at the end of runway 04 at Imphal. These Transmitters function on electrical energy supplied by battery on trickle charge. In case of power supply failure, standby generators supply power. If generator fails, the batteries continue to feed transmitter for approx. four hours. The transmitters are installed in air-conditioned room located in operational area at the airport. One transmitter works at a time and other is standby. The signals from equipment is radiated by aerial assembly installed at the stop end of runway 04.

The transmitted beam covers 35° on either side of centre line of runway 04. Localizer range is 25 NM

within ± 10° from the beginning of the runway. Further clearance signal is also generated which gives pilots indication of the vicinity of the aircraft from the extended centre line of the runway when aircraft comes within 35°. The range of this clearance signal is about 75% of the course signal. The vertical coverage of the Localizer Beam signal is 7.5°. The radiated signal is constantly monitored and its accuracy is automatically checked through monitors installed in the equipment cabinet.

(b) Glide Path :

The Glide Path equipment, type GCL 741, manufactured by Gujrat Communication & Electronics Ltd., comprises of two transmitters installed in an air-conditioned equipment room. Like Localizer, one transmitter is the main and other is standby. Power supply to Glide Path Transmitters is similar to the already stated earlier in case of Localizer Transmitters. One transmitter works at a time. The Glide Path facility provides elevation information to the aircraft at an assured distance of 10 NM. The normal Glide Path angle at Imphal is 3°. The radiation pattern is so adjusted that it gives a sector width from -0.3Øto + 1.75Øin vertical direction where Øis the prescribed descend angle. This signal is available within ± 8° with respect to extended centre line in horizontal plane while the aircraft descends to glide angle and maintain the correct position on Localizer.

The radiated signal from Glide Path system is continuously monitored by near field monitors. In case of out of tolerance signal radiated main transmitter will automatically shut down and standby start functioning. In case of radiation of out of tolerance signal by standby transmitter, the monitors will shut down standby transmitter also.

As per pre-determined and published approach procedure for ILS at Imphal, the aircraft is expected to report over VOR (Airport at a height of 10,000 ft.) and then in a holding pattern descend to 8000 ft. and then go outbound parallel to the extended centre line of the runway at a bearing of 217° (VOR) upto 2.5 mts. at 170 Kts. in a descending phase (8000 ft. to 5000 ft.). Then the aircraft initiates the procedure turn, turning left to 172° and then right to 352°. In this process, the pilot descends from 5000 ft. to 4200 ft. above mean sea level (AMSL). While turning inbound, he is expected to get the Localizer beam and follow the same until he is "on Localizer". The pilot then captures glide path and starts descending and gets glide path signal. The pilot will cross the Outer Marker at 4020 ft. AMSL.

The arrangement of monitors and remote control for Glide Path is identical with the Localizer described above.

(c) Outer Marker :

This facility is located at a distance of 4.5 NM from the threshold of runway 04. This facility is used as check point while aircraft makes ILS approach.

Audio-visual signals will be received by the aircraft while over the Outer Marker, the duration of which, when exactly aligned to the centre line of the runway, varies between 6 to 13 seconds. The height of the aircraft overhead Outer Marker should be 4020 ft. AMSL at Imphal.

(d) Middle Marker :

This facility identical to Outer Marker except it is located at a distance of 0.7 NM from the threshold of runway 04 and the expected height of the aircraft over Middle Marker is 2815 ft. AMSL.

(e) Remote/Status Indication :

Remote indication/control is available in the equipment room on the ground floor of the Control Tower Building. The indications are in the form of red and green lights. It shows the particular transmitter of Localizer/Glide Path emitting at any moment. Similar indications are available for monitors.

As per ICAO Annex-10, aerodrome Control Tower and Units providing approach control service should be provided without delay with information on the operational status of Radio Navigation Aids essential for approach, landing and take off at the aerodrome(s) with which they are concerned.

However, soon after the accident status indication lights in the Control Tower at Imphal were found unserviceable".

ILS at Imphal:

Inspector of Accident further reports that on the day of accident, all Navigational Aids at Imphal aerodrome were serviceable. As per recommendation by ICAO, flight inspection of ILS is required at 90 days $\pm$ 15 days interval. As per records, last periodic calibration check of ILS was carried out on 5.6.1991.

After the accident a special flight check of ILS was carried out on 18.8.1991 to ascertain its operational status. Except for course line alignment of Localizer all other parameters of Localizer and Glide Path were within limits.

In case of Markers except for higher duration of Markers indication, all other parameters were also within limits.

FLIGHT UNDERTAKEN TO LOCATE CRASH SITE WITH RESPECT TO IMPHAL VOR

The Inspector of accident reported that a flight was carried out on 19.8.1991 by Dornier aircraft of National Airports Authority, normally used for calibration flight. During this flight, the average time worked out from the Outer Marker to crash site and back at an altitude of 8000 ft. at a nominal IAS of 170 Kts. was 4 mts. 46 seconds. The crash site was found to be at a distance of 20.5 NM from VOR on radial 220°.

While it is true that the Inspector of Accidents reported that the distance between crash site and the VOR Imphal to be 20.5 NM, some doubt was expressed as to the correctness of the same by reason wherefor I had to undertake a special joureny to Guwahati for the pupose of ascertainment of correct distance, but by reason of bad weather conditions prevailing at Imphal, no success could be achived as more fully detailed under the chapter on 'General Outline of Investigation by the Court of Inquiry'. It would however be convienient to note at this juncture that a further attempt was made by the Court to ascertain the same by directing the Director General of Civil Aviation to obtain the necessary coordinates of Thangjing Hill and the distance from the top of the hill to the VOR Imphal to be certified by the Surveyor General of India in pursuance whereof the Deputy Director Tech. for the Director Survey (AIR) in the Directorate of Survey intimated the

Director General of Civil Aviation the coordinates of top of Thangjing Hill to be as follows :-

THANGJING (1915 M)

Latitude 24° 30' 12" N
Longitude 93° 40' 35" E

The VOR Imphal coordinates being

Latitude 24° 46' 01" N
Longitude 93° 54' 28" E

and on the basis of the above the distance between the above noted two points was certified to be 20.19 NM approximately. It is also to be noted that subsequent to the receipt of the above information, the Court also had it confirmed by a letter dated 27th March, 1992.

VOR at Imphal:

VOR facilities at Imphal is being provided by utilising the equipment WILCOX 476A, which was commissioned in September 1977. The facility was flight tested on 4.6.1991 and its operational status was declared unrestricted. The VOR at Imphal operates on frequency 116.9 MHz with identification code IIM.

Perusal of records indicated that VOR maintenance personnel at Imphal were taking meter readings of the equipment periodically and also was carrying monthly ground checks. It has been seen from the equipment log book that on 16.8.1991 VOR at Imphal was working satisfactorily at the time of accident of Indian Airlines Boeing 737 aircraft.

This VOR facility was flight inspected after the accident on 18.8.1991 to ascertain its status. During this flight check all

parameters of Transmitter-1 and II were within specified limits expect 30 Hz. Reference level of Transmitter-1 was high (actual reading 17.6 against the limit of 15 to 17). During the time of accident Transmitter-II of VOR was in operation on 16.8.1991.

Regarding flight inspection of VOR and ILS at Imphal undertaken by Flight Inspection Unit of NAA on 18.8.1991 (after the accident) it was confirmed by NAA that "VOR - all parameters have been found to be within defined limits. VOR Tx.2 which was in operation of 16.8.1991 VOR let down procedure checked and flyable.

ILS - Tx.1 of localizer and Tx.1 of glide path were in operation on 16.8.1991. Except for the course line alignment of localizer, all other parameters of localizer and glide path were within limits. Localizer course line was out by 21.9 UA against ICAO specification of 15 UA for the same". DGCA representative was on board for these flights.

Distance Measuring Equipment (DME) :

One of the most debated issues before the Court of Inquiry is in regard to the non-availability of Distance Measuring Equipment (DME) at Imphal Airport. Whereas the operator along with the ICPA submitted that in the event of there being a DME, this particular accident would not have taken place as the equipment is the only instrument from which the pilot is in a position to know his distance from a particular fix at any airport.

Admittedly and there is no manner of doubt that DME is a very useful navigational aid and is of very great assistance to the pilot in measuring his distance from VOR or ILS as the case may be. But the issue arises whether non-availability of DME can be ascribed to be the cause of the accident or even contributed to the accident. Before recording my own finding in regard thereto the evidence tendered before the Court ought to be considered.

Mr. S.K. Rastogi, Senior Acrodrome Officer, Incharge Imphal Airport, has stated that a DME is useful both for the pilots as well as for the Control Tower for the purpose of finding distance from the aircraft to the runway. Incidentally it is to be noted that all Boeing aircraft are fitted with a DME to correspond with a matching ground equipment. Mr. Rastogi, however, stated that in the absence of a DME there ought not to be any difficulty in the matter of measurement of a distance though by an indirect method. Mr. Rastogi explained the method being based on the ground speed and the distance from stations 'A' to 'B' in comparison with time. Though however, he has clearly admitted that this measurement would be by estimation only and which may differ by one or two nautical miles at best, it is the definite statement of Mr. Rastogi that apart from this estimation the pilot is getting certain other navigational aids enroute like VOR from where he can take his position and be more accurate as to how much time he should take therefrom. It is on evidence that by comparing the previous reporting position and the time one can easily make out the distance he shall have to cover. In general Mr. Rastogi's evidence is to the effect that there ought not to be any difficulty in the matter of safe arrival of the aircraft at a particular airfield even without having a Distance Measuring Equipment though it is very much desirable to have such an equipment at the station since it can give the distance without any further calculation. Mr. Rastogi further stated that in the event of disorientation of the pilot, the DME would be of very great assistance.

Capt. Mehta when asked specifically about the importance and usefulness of this particular equipment, categorically stated that DME does not form part of the standard ILS procedure but if it is available it will definitely help. According to him DME can be termed to be an additional assistance to the pilot. Capt. Mehta agreed with the view that there are other ground aids available at the Imphal airport and the pilot can very easily navigate the aircraft provided of course he follows and adheres to the laid down

procedures. Capt. A. Rahut also has stated that DME is a helpful guide.

Mr. Satendra Singh has also stated that DME would be an extremely helpful guide though cannot be termed to be a very essential requirement.

The evidence so far disclosed before the Court, therefore, leaves no manner of doubt that the DME is a helpful navigational aid, but cannot be termed to be an essential navigational aid since in the event of there being no DME, the pilot can co-relate his distance from the earlier reporting point as also from overhead VOR by calculation on timings. Incidentally, it is to be noted that the pilot has been given the let down chart of ILS on the basis of timings and speed and not on the basis of a distance. It is a time-oriented chart and not a distance-oriented one. The factum of time-orientation is fully within the knowledge of the pilots who fly into Imphal. It is to be noted further that there are approximately on an average two flights a day to Imphal and the pilots have been operating there without DME for the last several years.

This observation of mine ought not to be interpreted as undermining the importance and the assistance rendered by DME. I wish to clarify that absence of DME cannot be termed to be the cause of the accident since even without DME safe landing is otherwise possible with the assistance of other navigational and landing aids at Imphal Airport.

Let us now consider the converse situation also: this particular pilot Capt. Sekhar Halder immediately after crossing overhead Comilla has been giving wrong call-outs both in regard to altitude and distance as more fully appear from the CVR/FDR co-relation note above. The front panel instrument would definitely give an indication as to whether he was overhead VOR or not. The pilot unfortunately did not even bother to proceed on the basis of the panel instruments - had he followed the same, question of this

inquiry would not have arisen. There is not only non-adherence to the ILS let down chart but a total disregard of the front panel instruments - where is the guarantee, though may be a presumption, that the pilot would have adhered to the DME even if that was available. I have no hesitation to record that the entire course of conduct of the pilot after the aircraft has left overhead Comilla is rather slip shod and a total disregard for all normal procedures which a pilot is supposed to follow. It is to be further recorded that the CVR transcript does not show any emergency of any nature being experienced by the pilots at the cockpit. The attitude is as appears from the CVR transcript one of total cool and as stated by Capt. M.V.V. Rao as a copy-book transmission which when co-related with FDR depicts otherwise. As a matter of fact Capt. Rao himself has stated that he would not have given him the command licence if this FDR was made available to him after his command check. I am indeed sorry to record the same but unfortunately I am rather helpless considering the facts of the matter under investigation. Obviously, a sense of complacency has developed which has prompted the pilot to proceed in a manner as he has done while operating the flight from Calcutta to Imphal on the fateful day.

The other aspect of the matter ought not also to be lost sight of since a Distance Measuring Equipment was received admittedly at Imphal in July, 1991. In the normal course of events, one would expect that an equipment costing about rupees one crore would be immediately commissioned but this particular equipment has been allowed to remain at the airport in an unpacked condition at least till after the accident - a situation which cannot by any stretch be said to be warranted.

Automatic Direction Finder (ADF) - AD 200 :

During the course of hearing, both Capt. Bagchi appearing for the Indian Air Passengers Association and Capt. Mulherkar appearing for Indian Commercial Pilots' Association, in no uncertain terms suggested that if AD 200 was available with the Imphal

Air Traffic Control, the Controller would have known the direction of the aircraft and thereby could have saved the accident.

AD-200 is a VDF equipment and its usefulness cannot in any way be decried, but with the advancement of technological and scientific instrumentation of navigational aids, the absence of AD-200s is not felt in the same way as it used to be about a decade ago. The installation of VOR at the Indian airports has done away with the use of the AD-200s in this country. Admittedly, flying in these days has become totally pilot-oriented. AD-200 would not in any way assist the pilot on board the aircraft but it is a ground equipment through which the Controller can identify the direction of the aircraft and considering therefore the recent pilot-oriented approach, the National Airports Authority thought it fit to replace the AD-200s by installation of VORs.

It is placed on record that I had the painful duty of investigating another air accident involving an F-27 aircraft (VT-DMC) belonging to Vayudoot on 19th October, 1988 near Guwahati, Assam. In course of that investigation also the issue was raised and when asked the then Coordinating Director Mr. Tekchandani submitted a brief note which was quoted at page 80 of the Report. For convenience sake the same is also quoted hereinbelow :-

> "The AD-200 model of VDF equipment was available at many aerodromes in this country till around 1978/1980. The equipment in use had been serving at these airfields for over three decades and it had become increasingly difficult to maintain these equipments in serviceable condition because of the ageing of the equipment and non-availability of spare parts due to obsolescence. After careful consideration of various aspects including maintainability of the equipment upto prescribed standards, their necessity vis-a-vis the availability of more advanced Nav aids like VOR, the then DGCA decided to withdraw these equipment gradually from service. AD-200C, a later version of AD-200 was the last to be withdrawn from service in this Region at Bhubaneswar some time in 1988 when it was no longer possible to maintain the facility to desired standards.

On the question of its replacement by latest version, I would like to submit that the same was not considered necessary because the VOR, considered an advanced pilot interpreted and more versatile aid has been provided at most of the airports and the NAA is in the process of providing more VOR coverage of the Indian air space. Obvious advantage of the VOR over the AD-200 as a direction finder lies in the fact that the pilot can have its bearing with reference to the VOR tuned by him from the appropriate instrument in the cockpit continuously, whereas in the case of AD-200 the bearing of the aircraft derived at the ground had to be communicated by the Air Traffic Control to the aircraft whenever desired or necessary. The only advantage of AD-200 over VOR, if it can be so termed, lies in the fact that the ATC would know the direction of the aircraft in the case of AD-200 and not in the case of VOR which is a pilot interpreted aid.

I may also add that the latest generation of VDF equipment of the type in use at four international airports (imported from USA manufactured by Servo Corporation) is not indigenously available and that it is a costly equipment.

Considering the huge cost involved in providing the VDF equipment at all the airports in the country particularly in hard foreign currency, it would be appreciated by His Lordship and the Learned Assessors that NAA can go for this only at the cost of its present plans to improve and modernise the communication and Navigational aids in more crucial areas."

The findings on this particular issue so far as the earlier investigation is concerned ought also to be noted. At page 81 of the earlier report my observations to the following effect were recorded :-

"While it is true that AD-200 is an out-dated machinery, but its importance and usefulness cannot be decried. But considering the improved phenomenon of the ground aids, in my view, it would not be fair to put any blame on to the National Airports Authority as was sought to have been done by various parties appearing before the Court of Inquiry. With the AD-200, the ground control is in a position to know the location of the aircraft and in the earlier days used to communicate the same to the aircraft, but with the introduction of VOR, the same being now considered to be a pilot interpreted instrument and a more effective aid so that the pilot-in-command himself is in a position to locate his locations rather than depending upon the ground

control to inform him. In that view of the matter, installation of further AD-200s on the threshold of the 21st century, in my view, does not warrant further consideration and I accept the submissions made by Mr. Tekchandani on behalf of the National Airports Authority."

In the present context also since there is no new material on record or any additional evidence being adduced before the Court justifying a different view, I do not intend to retract from the earlier observations, but reiterate the same and note that with the advancement of technology question of introduction of AD-200 at this stage does not arise. It is not a replacement for a radar though a definite land aid which has lost its importance in the present day context.

Locator Beacons :

As narrated above the Instrument Landing System caters for the existence of an outer marker signal - it may be through a fan marker and a locator beacon or only a fan marker. Whereas the fan marker has a limited vertical range with a cone over which it provides audio and visual indications, the locator beacon is a non-directional beacon having a much wider range and would thus be a more positive assistance to the pilot in the matter of locating his position vis-a-vis the outer marker. The locator beacon will indicate as to the direction of the outer marker so as to allow the pilot to take corrective measures if there be any. Locator beacon is an additional assistance but cannot as such be termed to be an essential navigational equipment in an ILS procedure. Needless to say, however, that existence of a fan marker will suffice in so far as the safety aspect is concerned, more so by reason of the fact that the pilot is supposed to follow the procedure in its observance rather than in its deviations. At the Imphal Airport, there is a fan marker which gives both audio and the light blip and that by itself, in my view, would be a sufficient protection to the pilot for a safe landing. As noted above, locator beacon is an additional assistance and it is always better to have a further assistance if that is

available. Locator beacon is nothing but a low powered NDB through which the pilots are in a position to locate the outer marker with exactitude. It cannot thus, therefore, be regarded as a mandatory essential navigational aid but an additional assistance. It is on record that on the fateful day the fan markers at the outer marker and the middle marker locations duly emitted both audio and visual signals even just before the unfortunate crash as reported by Capt. L.P. Mishra being the Pilot-in-Command of flight IC-889 on 16th August, 1991. For convenience sake relevant extract of his statement is quoted hereinbelow :-

> "While operating flight IC-889 (Guwahati-Imphal) we approached Imphal on radial 282 (102° inbound) we were cleared to FL 100 and we checked overhead and proceeded outbound on 217° directly as it was not possible to join the hold as there was a cell. We did a normal L/D VOR and ILS landed normally. Navigational Aids at that time were functioning normal. Outer Marker (fan marker) we received both Audio and Visual signals besides we also monitored the L/D down on our ND/(Navigation Display)."

Capt. K. Patel, Commander of flight IC-255/256 on 16th August, 1991, landed at Imphal at about 1205 hrs. approximately, did not also report the non-availability of the outer marker signals. For convenience sake, the relevant extract from the statement of Capt. Patel is noted hereinbelow :-

> "I operated IC-255 Calcutta-Silchar-Imphal in morning departure was about 0615 hrs. in morning. When we approach overhead Silchar visibility at Silchar dropped to 1000M with rain and low clouds. As weather was below our minima, I diverted to Imphal which reported 7 kms. visibility and light drizzle. I carried out VOR ILS procedure and landed at Imphal. Weather was low clouds and visibility 7 kms. We sighted runway at about Outer Marker. Navigation aids at this time was working normal. After approximately 1 hour 45 minutes when Silcher improved we continued our flight to Silchar and Imphal. Second time when we landed at Imphal weather given was 5000 mtrs. and sky was overcast. I carried out VOR ILS and again sighted runway on Outer Marker. All navigational aids were working normally. For both the ILS approaches at Imphal I have reported overhead VOR at 10000 feet and join the hold to descend to 8000 feet and proceed

to outbound descending to 5000 feet and then descend to 4200 feet in procedure turn.

Even if the conditions are VFR, I will carry out VOR ILS procedure, keeping in view the terrain in the vicinity of the airport.....

While on ILS we cross check our height over outer marker 4,020 feet by audio and visual signal of marker (inbound)."

Incidentally, it is to be noted that immediately after the crash the particular channel of the ILS was sealed and the system was calibrated in the morning of 18th August, 1991 by the National Airports Authority with a representative of Director General of Civil Aviation on board the calibration aircraft. The calibration results depict that "on that day the transmitter (1) of the localizer and transmitter (1) of the glide path were in operation. Post accident calibration was carried out on 18th Aug. 1991. Except for the course line alignment of the localizer, all other parameters of the localizer and glide path were within limits."

From the report of the Shri K.V.N. Murthy, Executive Director, National Airports Authority, it appears that though there is slight deviation in the course line alignment of the localizer but the deviation is not to such an extent so as to alter the flight path of the aircraft since the deviation is to the extent of about 50 feet only. The glide path as noted above in the report, is in operation and there is no other infirmity in the equipments. In order to appreciate, however, the slight deviation in the course line alignment of localizer, I have had a discussion with Mr. K.V.N. Murthy, Executive Director (IP), the National Airports Authority and I did ask him to submit a report in regard thereto. For convenience sake, the same is set out hereinbelow :-

"The Flight Inspection Reports Nos. 1660 & 1660A indicate a course alignment of 21.9 micro amp. for both Transmitter 1 and Transmitter 2 of the Localiser at Imphal. This indicates that the course line information observed at the landing threshold would be displaced by 51.1 feet i.e. if the pilot follows the Localiser centre-line information, he would find himself 51.5 feet

away from the actual centre line of the licaliser at the threshold. As per ICAO, the permissible limit for such a displacement is 35 feet for Cat. I systems. This displacement was corrected by subsequent maintenance and correct adjustment confirmed by Flight Inspection Report No.1662.

The Flight Inspection Reports mentioned above, however, indicate that the structure of the localiser course to be well within tolerance i.e. there were no bends in the localiser beam."

The calibration report of the National Airports Authority is also annexed hereto and marked with letter 'G'.

10. **SEARCH AND RESCUE** :

The Inspector of Accidents Mr. R.K. Paul, who visited the crash site, in his report has stated as follows :-

"After duty ATCO Mr. Sen Gupta failed to establish contact with IC-257, he informed Shri S.K. Rastogi, Senior Aerodrome Officer (SAO) incharge of the aerodrome who immediately came and took over control and initiated different phases of emergency procedure. Several calls were given to IC-257. Also IC-890 and IC-256 (on ground at Imphal) called IC-257 but there was no response.

At 1248 hrs. IST Fire Station was alerted to keep a look out for IC-257. Indian Airlines was also informed and advised to contact IC-257 on their company channel.

IC-890 which was just airborne, was requested to proceed about 10/12 miles south-west of hill at 10,000 feet to find out IC-257. But due to cloud it was not possible to look out for IC-257 and this aircraft then set course for Guwahati. In the meantime, blind calls were given to IC-257 stating that it was cleared to land on runway 04 (considering communication failure).

It was determined from Indian Airlines that there were 62+1 passengers on board. At 1255 hrs. IST full emergency was declared. Fire station was advised accordingly with instructions to position their crash fire tender etc. to handle IC-257. City Fire Brigade/S.P. Fire, Imphal were contacted and requested to keep their crash tender ready for assistance. Deputy Commissioner & Supdt. of Police, Imphal were then informed about the missing aircraft on the final approach and requested to intimate D.C./S.P., Bishnupur District which falls on the final approach path since the aircraft is likely to be found in that area.

Guwahati and Calcutta were informed through HF/R.T. Regional Medical College and Ambulance Services and S.P. (CID) were informed. By 1305 IST all these agencies had been informed.

D.C. Imphal contacted to know the position of the aircraft and he was advised to organise search and rescue within or exceeding 5-15 miles south-West of the airport.

IC-256 which was cleared for departure at 1310 IST, was advised to search for IC-257, but due to cloud, he flew for about 5/6 minutes without any success and then set course for Silchar.

By 1330 hrs. IST Senior Aerodrome Officer (SAO) constituted Search and Rescue party. In the meantime, SAO also instructed acrodrome office to inform Delhi Hqrs., Chief Secretary, Joint Secretary (Home), Manipur regarding the situation.

I.G. Police and S.P. Imphal came to airport at 1335 hrs. IST and were briefed about the situation and also informed that the aerodrome search and rescue party was leaving for probable crash site towards Moirang. Search and Rescue Party started from airport at 1350 hrs. IST and reached the Office of the d.C. Bishnupur around 1600 hrs. On reaching the office of the d.C. Bishnupur, it was learnt that D.C./S.P. have left towards Moirang along with rescue team. The aerodrome search add rescue party came back to airport at 1650 hrs. IST. At 1658 hrs. IST it was learnt from State Authority that some villagers had informed that the aircraft had crashed at Thangjing hill just about 22 NM from the aerodrome. The message was relayed to Guwahati and Calcutta. However, SAO contacted D.C. Imphal about this message but was told that the authenticity of the message could be verified only after the rescue team reaches the site which would take about 5/6 hours due to very difficult terrain.

While search and rescue was being organised, S.P., Churachandpur, Mr. K.H. Netra received information around 1430 hrs. IST regarding the crash of I.A. Boeing aircraft through police radio control. He was asked to organise search party for locating the missing aircraft.

Mr. Netra got information around 1720 hrs. from S.D.P.O., Churachandpur that one villager reported to Moirang Police Station about one aircraft crashed at Thanging hill range. He along with his men, therefore, proceeded to the crash site. It was heavily raining and almost dark at that time. They could reach to Thangjing hill around 22:30 hrs. IST which is under the jurisdiction of Churachandpur. They saw one dead body and also experienced smell of burning oil. While proceeding further, they found more dead bodies and finally located the site. He found the aircraft was broken to pieces with dead bodies around it. There was no fire but smoke was emitting. He ascertained that there was no survivors.

Due to difficult terrain, heavy rain and dark night, he along with police force waited till dawn.

S.P. Churachandpur stated that 12 bodies were evacuated on 17.8.1991, 40 bodies on 18.8.1991 and remaining 17 bodies on 19.8.1991. On completion of the rescue work, all the bodies were brought down to the base camp at the foot hill by road with the help of police, B.S.F and other para-military forces and voluntary organisations. Finally, on completion of the rescue work, S.P. left the crash site after arranging to guard the place. The rescue work was also assisted by Manipur Rifle, B.S.F. and S.R.P.F.

Regional Controller of Air Safety, Calcutta and Senior Air Safety Officer (Ops.) were informed by Deputy Director Aerodrome, Shri G. Sarkar about this missing aircraft at around 1315 hrs. IST on 16.8.1991. Both of them immediately arrived at the search and rescue centre of Calcutta Airport. Information about locating the aircraft on Thangjing hill was received at Calcutta at around 17:00 hrs IST.

Honourable Minister for Civil Aviation, Secretary - Civil Aviation, Director General of Civil Aviation, Deputy Director General and Director of Air Safety arrived Calcutta at night and on next morning they all left in a special aircraft for Imphal. RCAS and SASO (Ops.) also arrived Imphal by the same aircraft. By the time the rescue operation was in full swing. As per the information received from the Police Control at around 1700 hrs. on 17.8.1991, 52 bodies were recovered out of which 12 were identified. By 19.8.1991, all bodies were recovered and identified.

Crash site was on difficult hilly terrain about 6700 feet ASL. Also due to inclement weather and difficult terrain rescue operation became very difficult task."

This Court, however, is not in a position to appreciate the role of the National Airports Authority in the matter of Search and Rescue. Mr. Rastogi, Senior Aerodrome Officer, and an official of National Airports Authority in no uncertain terms has stated that in the event of there being an air crash in the vicinity of the airport only the National Airports Authority is expected to take steps for search and rescue but not otherwise since that would be the responsibility of the State Government. I am to record here my total disagreement with this practice of the National Airports Authority. The National Airports Authority is one of the principle wings of the entire Civil Aviation industry in this country and it is true that their functions are specified but that, however, does not

mean and imply that there shall not be any obligation on their part to be a party in the matter of search and rescue in an air crash, even if the crash takes place at a place which cannot be said to be within the vicinity of the airport. Mr. Rastogi has been frank enough to state before the Court that on the first information of the crash near Loktak Lake in the afternoon of 16th August, 1991, he went along with the police officials but when nothing was found in and around the area of Loktak Lake, he came back without any further attempt to locate the wreckage. He is quite content in informing the Deputy Commissioner of Police to look for the aircraft. I did not find in him even at the witness box any anxiety in locating the crash site. As a matter of fact, according to his own statement, he got the information about the crash site next day morning when all the newspapers in the country reported the accident including its location. Is it expected of a Civil Aviation industry man to know of the crash site on the next morning, in my view, the answer cannot be in the affirmative. Safety of the people ought to be the foremost consideration for a Civil Aviation industry man in the country. Assuming there were some survivors, what would have happened to them if no medical attention was made available within shortest possible time - one does not know. Mr. Rastogi is the man on-the-spot, if he takes this attitude and sticks to his duty chart, it would be deemed to be a very sad day for the Civil Aviation industry in the country. The obligation to render assistance under any circumstances should be a prime consideration to an Aerodrome Officer. As a matter of fact, Mr. Rastogi's entire conduct does not seem to be in consonance with a sense of public safety and when the aircraft is to land, he is quite content to be "in his chamber and talking to the clients." That is the attitude which has been exhibited even in Court and which by no stretch according to me is proper. I am conscious of the fact that the Senior Aerodrome Officer has had some administrative work to do but that does not, however, mean and imply that when there were only three flights and all restricted by about mid afternoon, the Senior Aerodrome Officer will be in his Chamber talking to his clients at the time of the flight. There must be an anxiety in the

mind of the Senior Aerodrome Officer as to how things are proceeding at the Control Tower - there ought to be a sense of belonging to an Officer and he must be sincere for the purpose for which he has been asked to be there to cater for safety of the aircraft including the passengers. Does the conduct of the Senior Aerodrome Officer show such an anxiety or sincerity - I am afraid the answer cannot but be in the negative. It is true that Mr. Rastogi is a trained and experienced Officer, but the country has not been able to obtain the benefit of his training or his experience - a state of affairs which cannot by any stretch be said to be very encouraging. It is for the National Airports Authority to inculcate a sense of belonging on to its Officers so that public safety in not in any way impaired or there is any compromise in regard thereto.

Merely by sending an intimation to the police authorities, in my view, will not do - further steps are required to be taken which Mr. Rastogi, according to me, has failed.

On the basis of available materials on record, it appears that immediately on coming to know of the factum of the missing aircraft, the officials of the National Airports Authority, Calcutta, telephonically informed Mr. R.K. Paul, Regional Controller of Air Safety, Calcutta, who was later appointed as the Inspector of Accidents in this investigation and Shri Paul, on his part, also informed Shri Satendra Singh, Director Air Safety, in the DGCA Headquarters at New Delhi. According to Mr. Paul, it was almost certain that the aircraft had crashed. Subsequent crash information, however, was updated as and when further information was received from Imphal through the National Airports Authority, Calcutta. Finally, however, the information was received that the crash site has been located around 1700 hours on 16.8.1991 by a villager, which is at a distance of about 20.5 nautical miles from the Imphal Airport. The relief aircraft was made ready by the Indian Airlines, but the flight did not leave by reason of night landing restrictions at Imphal. As a matter of fact, the Minister of Civil Aviation Shri Madhav Rao Scindia arrived at Calcutta at night

itself so as to reach Imphal at the first available opportunity next day morning. It is to be noted that the Civil Aviation Minister proceeded to Imphal along with the Secretary, Civil Aviation Department; Director General of Civil Aviation; Deputy Director General of Civil Aviation; Director Air Safety, Hqrs. DGCA at New Delhi; Chairman Indian Airlines; Member Operations, National Airports Authority and the other local DGCA and Indian Airlines officials together with the relatives of the passengers on that ill-fated flight.

I have been informed that immediately on arrival at Imphal, the site was surveyed by the Minister-in-Charge of Civil Aviation in a helicopter provided by the Indian Air force. The Indian Airlines engineers and DGCA representatives had trekked to the site. It is not out of place to mention that the hill which was a mute spectator to the accident, was above 5,500 feet in height and the passage to the crash site was for all practical purposes out of bound to all and sundry, more so by reason of the fact of the heavy rain and slushy and steep terrain.

It appears from the report of the Inspector of Accidents that one Shri Thongram Birjit Singh brought the Cockpit Voice Recorder from the crash site and deposited with Bishenpur Police Station. The Inspector of Accident's Report also shows that one Shri Zamlet Haokip was the first person who knew that the aircraft accident had taken place at Thangjing Hill and one Shri Shamkhahen Haokip, was the first person who informed the Police Station about the aircraft accident. The report further disclosed that Shri K.H. Netra, Supdt. of Police, Churachandpur, received information around 1430 hours on 16.8.1991 regarding a missing Indian Airlines Boeing aircraft through a Police radio with the instructions to organise a search party for locating the missing aircraft. Initially Mr. Netra proceeded to Loktak Lake but subsequently around 1700 hours came to know that the aircraft, in fact, had crashed at Thangjing Hill range under Moirang Police Station. The Report of Mr. Netra records that after reaching the crash site, he found that

the aircraft was broken into pieces with dead bodies around it. Though there was no fire but smoke was still emitting and it was clear to them that there would be no survivors. Mr. Netra submitted that since it was pitch dark and no torches were even available excepting, however, the improvised fire which could be ignited, they had no other alternative but to wait till dawn as it was difficult on that hour to start the salvage work in darkness and in heavy rain. The report of Shri Netra along with the report of Mr. Priyokumar Singh being the Sub-Divisional Police Officer, Churachandpur are annexed hereto and collectively marked with letter 'H'.

I would fail in my duty as a Chairman of this Court of Inquiry if I do not mention the role and the effort of Manipur Adventure and Allied Sports Institute, Imphal (MAASI). The leader of the rescue team Shri N.J.K. Singh along with about 20 other young boys has not only rendered services but what I hear from other sources the rescue operation would have been extremely difficult without their active participation in such operation. I place on record my deep sense of gratitude and my appreciation to the leader Mr. N.J.K. Singh and his young friends for rendering such invaluable services for the cause of humanity.

The services rendered by Manipur Rifles, Central Reserve Police Force and Border Security Force also need special mention and reference. MAASI volunteers together with Manipur Rifles, Central Reserve Police Force and Border Security Force personnel have made it possible for the bodies being brought down to the base camp with extreme difficulty by improvised stretchers which should command praise from every quarter, since no mode of transportation could be made available from the crash site by reason of the terrain and the slushy condition on the slopes of the hill. The bodies had to be carried down personally on shoulders of the volunteers and other para-military force personnel. I was informed that the path was so slushy and was having such a steep slope that one person cannot even stand without a proper support

and even then MAASI volunteers and other para-military force personnel did not hesitate to render all possible assistance under the circumstances so that the bodies could be made over to the relatives as quickly as it is practicable.

Incidentally, it is also to be noted that from the base station upto the crash site, it has taken the search party about four hours of very steep climb - nothing was available, even a glass of drinking water and it is the villagers of the nearby villages who came forward with all their might and provided the drinking water and even some fruits to the volunteers enroute to the crash point. The gesture admittedly is admirable and I hereby record my sincere appreciation and thanks to those villagers who have spared no pains to be at different points enroute to the crash point to provide these facilities to the volunteers as otherwise it would have been extremely difficult if not impossible to bring down the bodies so quickly on to the base camp.

On the basis of the evidence on record, the first batch of bodies arrived at the base camp on 18th early morning and by about 19th all the bodies arrived at the base camp and subsequently transferred to the mortuary for the post mortem examination and immediately thereafter the bodies were made available to their relatives for the last rites. I also put on record my appreciation to Indian Airlines for allowing the relatives of the passengers of the ill-fated flight to proceed on to Imphal by air and to return to their respective destinations along with the bodies in wooden boxes free of charge - an indeed laudable gesture. Special mention should be had for Mr. Ramdas being the Chairman of Indian Airlines and Mr. Deb Burman, Deputy Director Commercial of Indian Airlines along with some other Indian Airlines officials by reason of their ardent effort to give solace and pacifying the relatives immediately after the crash. All the loved ones were there to have a last glimpse and it is an extremely difficult situation to manage. I have been told that both the above named officials of Indian Airlines have conducted themselves in such a way which cannot but be

termed praise-worthy. I record my appreciation and sincere thanks to them for their humane conduct and behaviour inside the mortuary at Imphal.

In fine, considering the location of the crash site and considering the slushy terrain, I am of the opinion that the search and rescue operation proceeded in a manner as is expected in such circumstances and no further, better or quicker arrangement could have been made.

11. **WRECKAGE INFORMATION** :

Details of wreckage information would appear from the report of the Inspector of Accidents and for convenience sake, the same is quoted hereinbelow :-

> "This aircraft impacted on the hill at a point approximately 200 feet from the top of Thangjing hill which is located 20.5 NM South-West of Imphal Aerodrome with a bearing of 220° from VOR. Although the aircraft had broken to pieces, wreckage was limited to a small area (400M X 100M) and could be viewed from the top of the hill. The inclination of the slope at the point of impact is about 60° to 70°. The major parts of the airplane were strewn with the empennage of the aircraft at the lower most point of the crash site. One wing was found to the left and another similar structure to the right. These were almost half-way of the crash site (longitudinally). Just above the right hand side wing, was one undercarriage identified as LH undercarriage. The nose wheel was almost on the top of the crash site. Due to massive destruction and parts disturbed by the local inhabitants, it was not possible to co-relate many positions during this wreckage examination. Also, there was post-accident fire which destroyed parts.
>
> However, it could be determined that the landing gear was in UP position as found from the landing gear operating actuator. Fore, mid and aft flaps were seen along with right hand wing separated from the fuselage. The flaps were out which corresponds to approach position. The horizontal stabilizer was cut off about 30" from extreme outboard end and right hand horizontal stabilizer was in one piece. Rear pressure bulkhead was separated from the fuselage. The fin, which separated out was clearly visible with I.A. monogram while engine was traced on the L.H. side, another engine casing was lying on the L.H. side of crash site."

Mr. D.K. Roy, the Deputy Engineering Manager of Indian Airlines at Calcutta, being one of the persons who also reached the crash site has stated that there was practically no road and it was the very tough journey. Mr. Roy stated that while he was going up, he found quite a lot of people coming down from the crash site with small articles belonging to the aircraft. At the crash site, the CVR was found out by one of the technicians of Indian Airlines being

carried by one person on his back. There was also a photographer and the latter was asked to take the photograph of the man carrying the CVR. The matter was reported thereafter to the police and the man was traced out and the CVR was recovered without there being any damage and with proper seals. The FDR also was located somewhere else around 30 kms away from the crash point in a village and was hidden in a banana bush. This FDR would not have been recovered but by reason of a generous taxi driver who came and reported the factum of the removal of the FDR from the crash site to a village and hiding it under a banana bush by a villager. It is to be placed on record that the FDR was recovered without also there being any further damage to the recorder excepting the impact damage. A wreckage distribution chart for convenience sake, is also annexed hereto and marked with letter 'I'.

12. GENERAL OUTLINE OF INVESTIGATION BY THE COURT OF INQUIRY :

Government of India vide Notification No.AV.15013/5/91-SSV dated 26th September, 1991 constituted the Court of Inquiry under Rule 75 of the Aircraft Rules, 1937, wherein I was appointed for the formal investigation of the crash of the Indian Airlines flight being No. IC-257 (the route being Calcutta-Imphal-Dimapur) on 16th August, 1991, near Thangjing Hill at Imphal, Manipur, to be assisted by Mr. B.P. Baliga, a former Director of Engineering, Air India and Wing Cdr. P. Ashoka, Executive Director, Hindustan Aeronautics Limited, as Assessors. Mr. A.K. Sinha, Senior Air Safety Officer, in the Directorate of Director General of Civil Aviation, Calcutta, was appointed as the Secretary to the Court of Inquiry. The Court was requested to submit its report by 31st December, 1991, but subsequently, however, the time was extended till 30th April, 1992.

It is to be noted that Mr. R.K. Paul, Regional Controller of Air Safety in the Directorate of Director General of Civil Aviation, Calcutta, was appointed as the Inspector of Accidents by the Director General of Civil Aviation immediately after the unfortunate crash on 16th August, 1991.

On the constitution of the Court, Mr. Paul did call on me and apprised me of the work which has already been done by him including examination of some witnesses. I requested Mr. Paul to continue and complete his investigation in the matter with utmost expedition.

On 8th October, 1991, I along with the Assessors named above, together with the Director General of Civil Aviation Mr. M.R. Sivaraman, Deputy Director General of Civil Aviation Mr. H.S. Khola, Director Air Safety in the Directorate of the Director General of Civil Aviation Headquarters Mr. Satendra Singh, the Inspector of Accident Mr. R.K. Paul and the Secretary to the Court of Inquiry Mr. A.K. Sinha reached Imphal for the purpose of an on-the-spot

survey of the crash site and obtaining necessary details in regard to the crash of the aircraft (VT-EFL). The Indian Air Force authorities did provide a helicopter for the purpose of a survey of the crash site, but in spite of our best efforts by hovering over the area in question in the helicopter, the survey was not possible by reason of the inclement weather conditions and the Thangjing Hill being overcast with clouds.

I, however, did have detailed discussions with the State Police and the aerodrome officials as also the doctors who performed the post mortem examinations of the bodies of the passengers and that of the crew members of the ill-fated aircraft. Next day morning also there was an attempt to have an on-the-spot survey but continuance of inclement weather prevented us from being at the crash site.

On return to Calcutta, however, I along with the officials of the DGCA and my Assessors inspected the engineering division at the hangars of Indian Airlines at Calcutta and ascertained the mode and method of doing the overnight checks. The Chief Engineering Manager Mr. S. R. Chakravarty and the Deputy Engineering Manager Mr. D.K. Roy, along with other engineering personnel of Indian Airlines assisted us whilst at the hangars. The Regional Director of Indian Airlines, Calcutta Region, Mr. U.P. Singh, was also present at the discussions. There were further discussions with the Executive Director, Calcutta, NAA Mr. S.C. Goswami and the Director of Aerodromes, NAA Mr. H.S. Roy.

On 11th October, 1991, I proceeded to Delhi for an assessment of the CVR transcript and FDR read-out which had already been effected by Mr. Satendra Singh, Director Air Safety at DGCA Headquarters. The two assessors were also present at the time of such an assessment of the CVR transcript and FDR read-out. At Delhi I met the Joint Secretary, Ministry of Civil Aviation, Mr. Ravindra Gupta, as also the Director General of Civil Aviation and the other top officials in the Directorate. At Delhi I had detailed

discussions with the then Chairman-cum-Managing Director of the Indian Airlines Air Marshal S.S. Ramdas, the Chairman of the National Airports Authority Air Marshal C.K.S. Raje, the Member Operations National Airports Authority AVM. H.M. Shahul, the Director of Operations Indian Airlines Capt. R.K. Kakkar and the Director of Flight Safety Capt. P.M. Jog. I also had a meeting with the Boeing Company's representative in India together with the representatives of Pratt & Whitney, the manufacturers of Boeing-737 engines in regard to the issue of engine failure as also the Ground Proximity Warning System (GPWS). The shearing of engines was also discussed at the meeting. There was a further meeting with the Pratt & Whitney representative at my residence at Calcutta on 14th October, 1991, wherein the issues as regards age of the engines and the engine failure were discussed at length.

In order to be certain about the structural stability of the aircraft on 20th October, 1991, I visited Bangalore and had discussions about the same including information on stress and strain analysis of the aircraft components with Prof. R. Narasimha, Director, National Aeronautical Laboratory (NAL), along with other officials of NAL in the presence of the Assessors. It is indeed not out of place to record that having detailed discussions in regard to the structural stability of the aircraft (VT-EFL), it came to light that question of there being a structural failure does not arise.

While the preliminary investigations were being carried out, I directed my Secretary to cause necessary advertisement to be published in all leading newspapers of the country so that any person having any knowledge and who desires to make a representation concerning the circumstances or the cause of the accident may do so in writing in the form of an affidavit sworn before a notary public or a Magistrate first class or any Metropolitan Magistrate and address the same to the Secretary, Court of Inquiry as constituted by the Government Notification noted above for investigation of the cause of the accident to the Indian Airlines Boeing 737 aircraft VT-EFL near Imphal. The advertisement was duly

published in all leading dailies of the country including the local newspapers at Manipur and Nagaland on or about 27th October, 1991.

To ascertain the flight path followed by the aircraft which ultimately resulted in the crash, I visited Bombay on 9th November, 1991 to have a simulator flight at the Air India A-310 simulator, on the basis of the FDR read-outs. Incidentally, it is to be noted that the A-310 simulator is one of the most modern and sophisticated simulator available presently throughout the globe and the effort was to obtain the flight path on the computer in order to avoid any misconception about the path followed by the aircraft. I record my sincere appreciation to Air India and in particular its Director of Operations Capt. D.S. Mathur and the Deputy Director Capt. J.R. Trilokekar and the other instructors of Air India who have assisted in such a simulation flight and obtaining a computer print out of the flight path on the basis thereof.

On 13th November, 1991, I visited the Civil Aviation Training College of National Airports Authority at Allahabad in order to obtain a first-hand information about the training system of the Air Traffic Control Officers. At the training institute, detailed discussions were had in the presence of my Assessors with the Member Operations AVM H.M. Shahul and other NAA officials. The entire syllabi was made available to us as also the methods of teaching and practical training aspects were noted.

On 16th November, 1991, I did visit the training institute of Indian Airlines at Hyderabad for the purposes of ascertaining the training course of Pilots as also to note the practical training aspect. Whilst at Hyderabad I took the opportunity of having a further simulation flight on B-737 simulator in order to ascertain the flight path of the aircraft.

In order to have the public hearings of the Court of Inquiry, I personally requested the Speaker of the West Bengal Legislative

Assembly Mr. Hasim Abdul Halim to provide me the Counsel Chamber (Syed Naushar Ali Hall) and Mr. Halim was gracious enough to accommodate me and permitted this Court of Inquiry to hold its sittings at the above Hall. I hereby record my sincere thanks to Mr. Halim for this accommodation. Needless to say that the Court hadn't had to pay any charge therefor.

Further advertisements were published in the newspapers for open sittings of the Court of Inquiry on and from 30th November, 1991. The Court did, in fact, commenced its proceedings on and since the above noted date.

During the course of hearing, I felt that the flight path of some of the earlier flights to Imphal undertaken by Capt. Shekhar Halder as Pilot-in-Command ought also to be examined so as to ascertain the mode and method of flying so far as Capt. Haldar is concerned. In pursuance whereof, I directed the Indian Airlines to make available to the Court at least four earlier flight data recorder foils for the purpose of examination. The Indian Airlines did comply with such a direction and made over four flight data recorder foils identifying the flights as that of Capt. Sekhar Halder on Calcutta-Imphal route.

After the foils were made over to the Court, the same were brought to Delhi by my Secretary and I personally supervised the readings on the foils and obtained necessary details therefrom. It is to be noted that the foils were decoded by Mr. Satendra Singh, Director Air Safety, DGCA Headquarters, and the FDR read-out for all the four foils were made available to the Court. Subsequently I directed the copies of the four FDRs to be circulated to all the parties so that necessary submissions may be made in regard thereto by the concerned parties.

Upon obtaining the four FDR read-outs, I directed Mr. Satendra Singh to go to Hyderabad along with Capt. Mehta, the then Operations Manager, Indian Airlines, Calcutta Region, to obtain a simulation path of the above noted four flights on the

Boeing 737 simulator and in accordance therewith within a short while therefrom, the four several flight paths on the route Calcutta-Imphal as plotted on a computer graph were made available to the Court by Mr. Satendra Singh.

For further confirmation on to the flight path, I did visit Bombay on 17th January, 1992 and had the simulator exercise and also obtained the four flight paths of the aircraft in regard to the above noted four FDRs.

Some confusion arose as the exact location of the crash site during the hearing by reason of which I directed the Deputy Director General of Civil Aviation to arrange for a further visit to Imphal for an on-the-spot inquiry. To facilitate the issue necessary arrangements were made to position an Emergency Locator Transmitter (ELT) at the crash site so that while flying on an A-320 aircraft necessary signals may be obtained in order to determine the correct distance of the crash site from the VOR point. Indian Space Research Organisation, Bangalore, was also requested to pick up the signal through satellite and indicate the coordinates of the source of signal. Though the ELT was placed at the crash site, but unfortunately due to bad weather conditions as also non-availability of the VOR at Imphal airport the flight to Imphal via Guwahati could not be operated on that day. The Bangalore Space Research Centre, however, obtained the signals and submitted the approximate coordinates of the crash site, but in order to confirm the exact location, the Surveyor General of India was requested to provide this Court with necessary coordinates which was made to this Court by way of a certification as stated above, suffice however to record here that the distance between the VOR Imphal and the top of the Thangjing hill has been certified to be 20.19 NM.

At the hearing, the issue of clearance of the hill on pilot's immediate reaction, upon the sounding of the GPWS came up for consideration and in order to appreciate it better, I went to Hyderabad on 1st March, 1992, and with the assistance of Capt. Thargaonkar and Capt. DeCosta, I did have a simulation exercise in regard thereto.

Altogether 25 Court sittings were held out of which 24 were at Calcutta and one sitting was at Imphal. The Indian Airlines, the National Airports Authority, the ATC Guild, the ICPA, the Air Passengers Association, the Aircraft Maintenance Engineers Association along with one Mr. Kapat being a social worker did participate at the hearing. In toll 27 witnesses were examined in detail on various aspects including the training of pilots, co-pilots and the ATCOs. The last of such hearing did take place on 7th March, 1992. It is to be noted that the sitting at Imphal was necessitated by reason of the fact that the local people would have an opportunity to express their views in the matter as otherwise it would not have been possible for them to do so at the Headquarters of the Court at Calcutta. As a matter of fact, one Mr. Irengbam Boyaisingh came up before the Court and stated that from the newspaper report he came to know that the pilot of the ill-fated aircraft wanted to have an emergency landing but the ATCO did not permit him to land and asked him to wait for ten or fifteen minutes. This confusion, however, had to be cleared since there was no permission sought for by the aircraft, neither any emergency existed and in that view of the matter, this Court made over a copy of the CVR transcript to him and asked him to appear before the Court after the luncheon recess. Apparently he was satisfied that there was no such emergency existed since he did not come back after the recess. It is also to be noted that on his prayer that the belongings of his father, being a victim of the crash, which were lying at the Police Station and the Deputy Commissioner of the Police of the area was directed to release the same within 24 hours from the date of the order.

Subsequently, however, at the request of the Government, I did visit Sydney in Australia and Singapore for the purpose of undertaking a study as regards the training standards in these two countries with a view to upgrade the training in India, if it is so required. It is to be noted that I left the country in the evening of 10th April, 1992 by Air India flight from Calcutta and upon completion of the study as requested, arrived at Calcutta in the afternoon of 19th April, 1992, instead of 22nd April, 1992, as scheduled earlier.

13. ANALYSIS OF EVIDENCE TENDERED BEFORE THE COURT OF INQUIRY:

The evidence tendered before the Court of Inquiry for the purpose of correct appreciation may be sub-divided under the following heads :-

i) Possibility of sabotage;
ii) Airworthiness of the aircraft;
iii) Calearance to direct outbound approach;
iv) Flight path followed by the ill-fated aircraft vis-a-vis the operational flight plan and the ILS let down chart;
v) Role of co-pilot during the flight.
vi) Possibility of wrong indication by VOR;
vii) GPWS warning and crew response.

It will be convenient to deal with the above seriatim:

i) Possibility of Sabotage:

The Indian Airlines Boeing-737 (VT-EFL) while on a scheduled flight on route Calcutta-Imphal-Dimapur being flight No.IC-257 crashed near Imphal Airport into the hill slopes of Thangjing Hill with its nose hitting a place approximately 300 feet below the summit of the hill. Major C.B. Lal, Controller of Explosives, Bureau of Civil Aviation Security, Calcutta Airport, visited the crash site for an on-the-spot visual inspection and examination of the wreckage on 17th and 18th August, 1991 for the purpose of ascertainment of the factum of there being any sabotage. It is the definite evidence of Major Lal that he has not seen any positive signature of explosives or explosion in the aircraft on the wreckage examination. Major Lal pointed out that if there was a bomb planted on the aircraft and an explosion resulting therefrom, there would have been definite signatures on the metal as well as in the various wreckages of the aircraft and on the dead bodies. In his evidence he has explained the positive signatures as (a) the formation of distinctive surface effects such as pitting or very small

craters formed in metal surface caused by extremely high velocity input from small particles of explosives and such craters would have raised or have rolled over edges and often have explosive residue in the bottom of the craters; (b) the surface effects would have shown metal fragments produced by explosives and would have caused deformation mechanism which are peculiar to high rate of strain at normal temperature together with a dislocation movement: because the process in an explosion is thermally activated at a very high rate of strain. Major Lal explained that in some metals such as copper, iron and steel deformation in the crystal of the metals takes place by twinning, that is to say, the parallel lines or cracks cutting across the crystal. He went on to say that such phenomenon can only occur if the specimen or the subject has been subjected to extreme shock wave leading at velocity in the order of 8,000 metres per second.

On a pointed question from the Court as to whether the wreckage, as it is in the matter under investigation, can have the same affectation in the event of an object hitting the aircraft from ground, to wit, a missile, the answer of Major Lal, however, was in the negative, since it will create a perforation and then as usual the explosive blast would be there. Major Lal observed that in that event, there are also chances of pieces of missile overhead portion being available at the wreckage site and as such an external object being thrown and hitting the aircraft cannot but be ruled out and so is the sabotage by means of a bomb being planted on board the aircraft. The report of Major Lal depicts that on examination of wreckage, centre of explosion and explosion pressure profile could not be determined as damage to the aircraft's one wing, nose, cockpit and passenger cabin was total and similar as in the case of resultant impact of high speed aircraft. The phenomenon of fragmentation, curling/ringlet effects and spike tooth fractures in metal surface were also not observed on visual examination. The phenomenon of cupping/dishing of metal surface, high velocity penetration of fragments in interior furniture, cushion and plastic fitments due to explosion were not observed. Major Lal reported

that in the light of visual inspection of the crash site and examination of wreckage in-situ, the theory of mid-air bomb explosion and sabotage is rejected. For convenience sake, however, the report of Major Lal on the issue of sabotage is annexed hereto and marked with letter 'J' (the photographs and charts though enclosed with the report and exhibited before the Court of Inquiry are, however, not included in annexure 'J' to avoid the bulk).

ii) **Airworthiness of the Aircraft** :

As noted above under the head Aircraft Information, this particular aircraft VT-EFL was delivered to Indian Airlines on 3rd December, 1977. The Certificate of Airworthiness was last renewed on 26th November, 1990 and was valid upto 27th November, 1991. The aircraft as per the available evidence on record, both documentary and oral, was maintained on the basis of approved maintenance schedules and all mandatory modifications and inspections stipulated by the Directorate General of Civil Aviation have duly been carried out. Mr. D.K. Roy being the Deputy Engineering Manager, Indian Airlines, Calcutta, has stated that this particular aircraft was duly checked by the Engineering Department in all its schedules and he was personally involved in regard thereto. The Check 'B' Inspection Schedule was carried out on the night of 15th August, 1991, ending in the morning hours of 16th August, 1991. The document pertaining to the Check 'B' schedule has duly been signed by five different persons in the Engineering Division of Indian Airlines. Mr. Roy has further stated that as a matter of fact the aircraft had come on the day before from Delhi to Calcutta via Lucknow, Patna and Ranchi and then it had done the flight in the route Calcutta to Hyderabad via Bhubaneswar and back before the Check 'B' Schedule was carried out. It is not out of place to record that the Check 'B' schedule includes inspection of electrical and other navigational aids of the aircraft. Mr. Roy has further stated that usual pre-departure check was also carried out prior to the departure of this aircraft from Calcutta for Imphal and Dimapur. No snag was reported on the earlier day

when the aircraft was in flight either from Delhi to Calcutta as above or from Calcutta to Hyderabad and back excepting that the APU (Auxiliary Power Unit) generator was non-functioning. The APU snag, however, was allowed to continue even after the Check 'B' inspection as by reason of the non-availability of spares at Calcutta, the unit could not be rectified, but the aircraft was certified to be fit to undertake the flight by reason of the fact that APU is one of the MEL items which permits the operator to carry forward the snag upto a period of 72 hours.

While it is true and as appears from the evidence that there will be no compromise with the safety of the aircraft in the event of the APU generator being unserviceable, but it does not bespeak of proper administration on the part of the operator, more so when Calcutta is a major air base for Boeing 737 aircrafts with all the major inspections upto Check-I level are being carried out at Calcutta. It is to be noted further in this context that all checks upto 1,500 hours of the Boeing 737 aircraft are done at Calcutta and beyond that the checks are always being carried out at Delhi and as such spares ought to be made available at Calcutta as otherwise there is likelihood of such snags being carried forward probably upto its last limit, namely, 72 hours which cannot by any stretch be said to be an encouraging state of affairs.

From the available records, it appears that this particular aircraft VT-EFL was not involved in any major incident necessitating any major structural repair.

Needless to record here however, that during the flight no emergency was transmitted by the flight crew at any point of time prior to the crash. The CVR recordings also show that there was no intra-cockpit conversation indicating any aircraft snag during the flight. The report of the Controller of Explosives, Calcutta Airport, indicates that the entire wreckage of the aircraft was located within a small area thereby depicting that there was no inflight structural failure as otherwise it would have resulted in a much

wider scatter of the wreckage. It is also pertinent to note that the FDR data does not show any abrupt change in aircraft flight parameters and the data indicates that it was a fully controlled flight till the time of impact.

On the basis of the above discussions, it can thus be safely concluded that the aircraft (VT-EFL) operating flight IC-257 (Calcutta-Imphal route) was fully airworthy prior to its departure from Calcutta and during the course of entire flight until the time of impact.

While it is true that the aircraft was otherwise safe and secure for undertaking the flight, but I will be failing in my duty if I do not record certain observations of mine in regard to the maintenance facility at the Calcutta Airport as also in regard to the MEL items.

The existing facility at Calcutta Airport for undertaking maintenance work though cannot be said to be lacking in any way amenity-wise but discussions with the engineers and technicians reveal that slightly better facility may be made available specially during the night time. The availability of spares at Calcutta airport, however, need also to be augmented.

Coming back on to the MEL item in slightly more greater detail, it is seen that the manufacturers of the aircraft has itself provided for carrying forward of certain snags, the list of which appears from the manufacturers Masters Minimum Equipment List. The Director General of Civil Aviation, however, upon consideration of the Indian situation modified the list by providing lesser number of items in the MEL so as to conform to the Indian conditions, considering the total safety aspects of the flight.

Another redeeming feature came to light during the course of investigation to the effect that while it is true that no snag is allowed to continue from the major base after the night halt, but if

the snag is detected one hour prior to the departure and the snag being one of the MEL items, the aircraft can be cleared with the snag carried forward. The operator seems to be quite content with this sort of practice but in my view the sooner it is dispensed with the better for safety sake since there is likelihood or at least the possibility cannot be ruled out that this detection at the late stage may be a deliberate one.

iii) **Clearance to Direct Outbound Approach** :

The most controversial issue in this inquiry is in regard to grant of permission by Air Traffic Control to go directly outbound on the basis of a request from the pilot for setting course directly outbound for let down.

In order to appreciate and to deal with the matter in its proper perspective, the approach briefing by Pilot-in-Command to the Co-pilot for convenience sake ought to be noted. The CVR transcript for approach briefing reads as follows :-

07:01:59	P1	P2	Visual - - or otherwise we will go overhead 10,000 feet then on the hold cleared to 8,000 feet and 070 this will be tear drop entry inbound 217 after that leaving VOR 217 8000 to 5000 feet check time two and half minute and then in descending turn to 4200 and then further descend on interception glide slope only correction 5,000 feet then a procedure turn after that further interception with glide slope descending to decision height 224. Then in case of missed approach climb straight ahead to 4200 feet then turn left to join VOR holding climbing 8,000 feet.

Before proceeding further, however, it is to be noted that as per the flight plan and the let down chart, the aircraft is to come overhead VOR from South-Westerly direction at a heading of 070° and after reaching overhead VOR and upon completion of the holding pattern there itself should follow a radial of 217° for outbound leg.

Coming back to the CVR transcription as recorded above under the head 'Approach Briefing' being an intra-cockpit conversation between the Pilot-in-command and the Co-pilot, it appears that while descending to flight level 135 and as a matter of fact much before even the aircraft was abeam Khumbigram, the Pilot-in-Command decided to make a tear drop entry after coming overhead VOR at 10,000 feet and the permission sought and the subsequent approval granted by the ATCO shall have to be considered on this background that at no point of time the pilot wanted to complete the holding pattern overhead VOR but some such turning which would permit him to avail of radial 217° from 070°. Four transmissions as appear from the CVR transcript between 07:09:45 to 07:09:59 (UTC) ought to be noted at this juncture being the basic transmissions in regard to the issue in question. The transmissions read as follows:-

07.09.45	IC-257	Imphal	Now, we are one two miles inbound at ten thousand 1009.
07.09.53	Imphal	IC-257	O.K. maintain report overhead VOR.
07.09.55	IC-257	Imphal	Roger Overhead, can we set course directly outbound for let down.
07.09.59	Imphal	IC-257	Roger, you are cleared.

The transmissions above, depict that when the aircraft reported 12 nautical miles away, the tower told the aircraft to maintain and report overhead VOR. There cannot be any manner of doubt that the controller at the tower required the aircraft to report as and when aircraft reaches overhead VOR. The next transmission is recorded at 07:09:55 i.e. barely two seconds after the tower's requirement to report overhead VOR, through which the Pilot-in-Command sought permission to set course directly outbound for let down and the tower shortly thereafter granted such a permission by transmitting "Roger, you are cleared".

Two very senior and experienced pilots of the operator were examined and both of them in no uncertain terms stated that there cannot possibly be any scope for avoiding overhead VOR while landing at Imphal Airport. As a matter of fact, the intra-cockpit conversation corroborates such statements.

Capt. Mehta in answer to Question No.215 has stated that the pilot has to go overhead and by direct outbound what he meant was, he shall not join the holding pattern and turn right by 30° so that he can pick up 217° and proceed. Further in answer to Question No.216 Capt. Mehta categorically stated that when people ask for direct outbound, it is just on coming overhead and proceeding outbound directly but after coming overhead VOR. Incidentally it is to be noted that on a pointed question from the Court, Capt. Mehta stated that with 8 octa cloud he would never ask for a permission for a direct outbound without joining the holding pattern of overhead VOR.

Capt. Rahut, another very experienced pilot of the operator also in no uncertain terms stated that even if one wants to come direct outbound, there is no escape but to come overhead VOR and then go on radial 217 and direct outbound does not mean that he will not go overhead VOR (vide Q. 130 to 134).

On a plain reading of the statements, it is, therefore, clear and apparent that the permission to set course directly outbound obviously mean and imply, when overhead and not to set coarse directly outbound for let down from that point itself. Both Capt. Mehta and Capt. Rahut have in no uncertain terms stated that pilot shall have to come overhead VOR in any event. The ATCO also if under that belief, cannot thus be said to be wrong more so by reason of the fact that a distance of 12 miles cannot be covered in just two seconds. It is an inconceivable idea that a pilot would commence a let down without getting a ground fix ,namely, overhead VOR. Further, it is to be noted that the pilot, in fact, at 07:11:26 UTC transmitted on an enquiry from the Tower about the position of the aircraft as "We are approaching overhead". It is in evidence that setting course directly outbound can be affected by making a loop or a tear drop entry and it is as per the choice of the Pilot-in-Command. The Senior Aerodrome Officer Mr. Rastogi has stated such a tear drop entry is permissible and as a matter of fact the pilot among themselves have decided to make a tear drop entry overhead VOR. Incidentally it is to be noted that at the approach briefing the pilot has in no uncertain terms stated that visual or otherwise he will come overhead VOR at 10,000 feet and obtain radial 217 after a tear drop entry.

Can it thus be stated that the transmission from the Tower to the pilot in approval of the request of the pilot to go direct outbound has really mislead the pilot - in my view the answer cannot but be in the negative. The pilot is responsible for safe landing at the airport - he has to decide what approach he will make; the ATCO does not have any say in the matter, though however, some amount of extra care on the part of the ATCO would undoubtedly have been better. It is the standard procedure that the pilot shall have to report overhead VOR, as a matter of fact the ATCO did ask the pilot to report when overhead VOR and the pilot in turn has acknowledged it by using the expression 'Roger'. Subsequent transmission approaching overhead from the pilot and "understand proceeding on a radial 217" ought also to be consid-

ered. Radial 217 is the correct flight path which a pilot should follow - reminding the pilot of his radial even if the pilot is proceeding direct outbound - in my view ought to have given the pilot sufficient indication so far as safety is concerned from the ATCO's point of view. It is for the pilot to manoeuvre the aircraft and obtain the radial 217 and not for the ATCO to bring him on to radial 217 from overhead VOR - afterall the pilot is incharge of the aircraft and not the ATCO. Considering the matter from the other point of view, even one cannot but come to an inescapable conclusion that the pilot understood by such transmission from the Tower that he shall have to come overhead VOR as otherwise he would not have transmitted at a subsequent point of time that he is approaching overhead VOR. This factum of subsequent transmission negates the theory of the pilot being mislead by the grant of permission for direct outbound. It is needless to say that it is a pilot who has sought permission to go direct outbound and not the ATCO on his own required the aircraft to go direct outbound. The ATCO only approved the approach of the pilot which under the normal circumstances the ATCO permits. Assuming, the pilot asks for a visual approach since the runway is in sight - would the ATCO negative such an approach - in the normal circumstances the answer is in the negative - the reason being the pilot ought to know what approach to make for safe landing of the aircraft and this is a standard procedure to grant permission to a visual approach for landing when such a permission is sought for. The transmission under consideration is also one such approval on the pilot's seeking such a permission - moreso, by reason of the fact that the approach is a pilot-oriented approach and not a radar-vectored approach wherein the ATCO is the person responsible for safe vectoring of the aircraft upto final approach for landing.

Turning now on to the other aspect of the matter as to whether this particular call-out can be termed to be a justifiable call-out - Capt. Mehta in no uncertain terms stated it to be an absolutely wrong call-out. Let us now try to analyse the situation in a slightly more greater detail. The flight plan available to the

pilot depicts that he should approach overhead VOR with 070° heading which mean and imply that the aircraft should be approaching the VOR from the South-West direction. Having the heading in mind, it would be a near impossibility to obtain outbound radial 217 before outer marker unless, however, the pilot comes overhead VOR and follows a tear drop turn or joins the VOR hold for proceeding outbound since the angle of turn would otherwise be extremely difficult to manoeuvre.

On the basis of the above, it can therefore be safely concluded that this particular call-out seeking permission to go direct outbound cannot be termed to be a proper call-out but a wrong call-out as Capt. Mehta described it. As a matter of fact, the pilot wanted to cut short his timings, which has unfortunately placed him much beyond the safety zone. The details of the pilot's action, however, would be dealt with hereinbelow.

iv) **Flight Path followed by the ill-fated aircraft vis-a-vis the Flight Plan and ILS Let Down Chart** :

The operator for all its routes evolved various operational flight plans detailing out the headings at different points of time for the entire route and Imphal is no exception. The flight plan for Calcutta-Imphal sector categorically states the MORA - 10,000 feet. In ordinary common English parlance MORA - 10,000 feet mean and imply safe altitude upto 10,000 feet. The elevation of the airport has also been given at 2,536 feet. The details of flight plan for Calcutta-Imphal sector would appear from page 5 of this report; Chapter 2 "The Unfortunate Flight". The flight plan depicts a total flight time from Calcutta to overhead VOR Imphal to be 52 minutes and a further eight minutes time has been added to facilitate landing at the airport on ILS let down chart from overhead VOR. Considering the flight plan as above, the entire flight timings from Calcutta to Imphal is to the extent of 60 minutes. The flight plan takes care upto overhead VOR Imphal and the let down chart thereafter guides the pilot to land safely on the airport upon follow-

ing the standard ILS procedure as per the let down chart and that precisely is the reason why the let down chart commences from overhead VOR at Imphal Airport. There is definite evidence that in the event the pilot follows the flight plan and the let down chart, question of there being any hazard or there being any compromise with safety would not arise.

The FDR data as available from the FDR read-out, indicates that the Pilot-in-Command of the ill-fated aircraft IC-257, in fact, followed the flight plan in its entirely upto Comilla and there exists no deviation whatsoever from the flight plan. The deviations, however, started only after the aircraft crossed over Comilla. FDR data records that instead of 007 heading, the aircraft followed 053, completely by-passing overhead Agartala. The CVR transcript, however, records a transmission at 06:51:44 UTC as approaching overhead Alpha Alpha Tango, but as noted above, the FDR data tell a different story. The aircraft was nowhere near Alpha Alpha Tango - why this call-out then - obviously to give an impression that the flight plan is being obeyed in its entirety and there is no departure therefrom. If the pilot does not give such a call-out, the same obviously would be noted and he might be put to books which no pilot desires. Capt. Mehta describes it as a total indiscipline of the pilot and so does Capt. M.V.V. Rao. It is neither fair nor reasonable on the part of the pilot of an aircraft to give a wrong call-out. This is not the end of the story but just the beginning. Question obviously crops up as to how a pilot having followed the chart in totality upto a certain point has deviated thereafter - the answer is not very far to seek: From Calcutta to Comilla there is every likelihood of the flight path being monitored by the Radar Controller both at Calcutta and at Dhaka but beyond that question of there being any screening of the flight path would not arise since there is no radar control at Agartala or at Khumbigram or at Imphal. The pilot, therefore, innovates his own procedure and a new flight plan cutting corners here and there. I hereby record my concurrence with the observations of Capt. Mehta that there is total indiscipline - why on earth a pilot would report

overhead Agartala when, in fact, he is nowhere near VOR Agartala - a grossest possible indiscipline. The FDR data shows that instead of having a heading of 007 the pilot-in-command in fact proceeded to a heading 053 and continued to do so for a period of about 12 minutes, when in fact, he was supposed to fly with a heading of 007 for a period of four minutes and thereafter with a heading of 070 till such time he comes overhead Imphal. It is to be noted that after flying about 12 minutes, the pilot changed his heading to around 81° and continue to fly on the same heading for a period of about nine minutes and subsequently changed his heading close to 70°. But why this departure from the flight plan - cutting corners with an aircraft is not only unsafe but connotes a total lack of professional ethics for an airman. Two experienced pilots and the senior trainer of the operator have deprecated such an attitude of the pilot and ascribed it to be an act of indiscipline. Cutting corners is not the only indiscipline noted in the pilot. As noted above, wrong call-outs is another redeeming feature of this particular pilot operating the ill-fated flight. ATCO's enquiry as to the altitude has also been the victim of such an indiscipline. The FDR/CVR co-relation note as above, dealt with this aspect of the matter in detail, suffice it however to record that this attitude of transmitting wrong altitudes to the ATCO may even result to a much worst catastrophe had this been happening in a major international airport where air traffic density is more.

Incidentally it is to be noted that flight plan ought to be observed in its observance rather than in its departure therefrom. I am constrained, however, to record that there was an effort on the part of the operator to give an impression to the Court that one can deviate from the flight plan and no exception can be taken in regard thereto. Though, however, subsequently on pointed questions from the Court, the evidence tend to show that it is a question of 'must' as regards the observance of the flight plan and it can only be varied or be deviated from upon special permission from the Air Traffic Controller and that also is more or less restricted to unusual situations and in the event of visual landing -

which is understandable. A pilot experiencing heavy turbulence and a cb cloud, then with the permission of the Air Traffic Controller, he might deviate his course but come back to the required track after avoiding the above eventualities - these are not in the normal expectations but under unusual circumstances and nobody can take any exception therefor, but in the normal circumstances it is now an admitted state of facts that the pilot should adhere to the flight plan in its obedience.

The following tabulation indicating the action of the Pilot-in-Command vis-a-vis the FDR and CVR data will corroborate the above observations :

TIME (UTC)	FLIGHT PLAN			FDR DATA		CVR TRANSCRIPT
	CHECK POINT	TRACK	ALT	HEAD.	ALT	
06:24:00	Take-off from Calcutta					
06:31:00	FIR CF/FR	073		072	16732	
06:39:00	TOC	073	29000	073	27608	
06:40:00	BAVAN	073	29000	073	28933	
06:44:00	AGUNO	073	29000	076	28933	
06:48:42						
06:49:00	VGCM	073	29000	054	28933	Agartala, India 257, over Charlie Mike Lima.
06:50:00	FIR FR/CF	007	29000	054	28933	
06:51:44						
06:53:00	VEAT	007	29000	054	28933	Roger India 257, approaching overhead Alpha Alpha Tango.
06:58:34						
06:58:51						Imphal India 257 negative traffic with Silchar descent from level 290.
						Victor 257, Roger descent to flight level 135 report reaching.

TIME (UTC)	FLIGHT PLAN			FDR DATA		CVR TRANSCRIPT
	CHECK POINT	TRACK	ALT	HEAD.	ALT	
06:59:08				054	28073	
07:04:14				(Commenced descent at this time)		
07:04:48						We are abeam Kilo Kilo Uniform in contact with Imphal.
07:05:00						
07:08:00	Abeam KKU	070	29000	081	10405	Our revised overhead Imphal is 0712. and level approaching 135 further descent.
07:09:00	TOD	070	29000	076	10140	
07:09:45						
07:11:29						Now we are one two miles inbound at ten thousand, 1009. (In fact, however, the aircraft was about 23 miles away from overhead VOR).
07:12:00	Overhead Imphal	070	10000	217	5554	We are approaching overhead. (In fact, however, the aircraft was about 14 miles short of overhead VOR).

On the basis of the above noted tabulation, three main deviations with respect to flight plan come to light and the same are being noted hereinbelow for convenience sake :-

As mentioned earlier the total flight time from Calcutta to overhead Imphal is 52 minutes as per the operational flight plan. The ill-fated aircraft took-off from Calcutta at 06:24 UTC and hence was estimated to come overhead Imphal VOR at 0716 UTC. After the aircraft came in contact with Imphal, it reported at 06:54:22 hours UTC that it was maintaining flight level 290 and was estimating overhead Imphal at 07:16. After reaching overhead Comilla, the aircraft instead of going overhead Agartala, took almost a direct route to Imphal and it appears that as a result of this short-cut, the flight crew reported to Imphal ATC at 07:04:48 that its revised estimated time of arrival overhead Imphal was 07:12 hours UTC indicating thereby that it would reach Imphal four minutes ahead of the earlier estimated time of arrival.

In accordance with the flight plan, the aircraft is expected to commence descent about 45 minutes after take off from Calcutta which in the present case would be 07:09 hours UTC. From the co-relation of CVR and FDR data, it is observed that the aircraft had actually commenced descent at 06:59 hours UTC i.e. 10 minutes prior to the expected time of commencement of descent. Even if the revised ETA is considered, the descent should have commenced around 0705 hours UTC. No valid reason could be given under the prevailing circumstances as to why the commander commenced descent so early - it only reflects disregard to the laid down operating procedures by the flight crew. It may be mentioned that in such situation when the crew commences descent much prior to the time indicated in the flight plan, the estimated time for the flight would vary on account of change of true air speed and the commander would not be in a position to estimate his correct time of arrival at the destination. It is likely that this may have been a factor that the crew were not knowing exactly their position while approaching Imphal and gave incorrect

position reports. Since on account of early commencement of descent, true air speed during descent would be lower than the true air speed taken into account for estimating flight time given in the flight plan, it is likely that when the crew estimated that they would be approaching overhead VOR, they were actually much away from the VOR which may have been a factor for early commencement of right turn for ILS let down. It is, therefore, needless to emphasise that such deviations from the flight plan could cause serious problems during the flight. Incidentally, it is to be noted that Capt. Bagchi representing the Air Passengers Association also expressed more or less similar view in his arguments. Capt. Bagchi submitted "The flight as per Operational Flight Plan should have commenced descent from F.L. 290 at 0709 or 0705 - revised; which is 1 mt. after abeam Ku. The descent permission was given at 06:58:51 approx. 6 mts. earlier, thereby losing TAS and this actually delayed arrival over Imphal, which was probably not considered. This miscalculation made the flight to turn right for outbound earlier". It is, however, clarified that descent clearance may be given by the ATCO at an earlier point of time but actual commencement of the descent is dependent upon the pilot and the ATCO has no say in regard thereto. In any event in the matter under consideration the descent clearance was given to the aircraft by the ATCO at the request of the flight crew (NOTE - Instead of Silchar it should be read as Imphal in the CVR transcript at 06:58:34).

Another deviation which was observed from the Cockpit Voice Recorder transcript was that at 07:08:44 hours UTC, the Pilot-in-Command had informed the Co-pilot that they were 25 miles from Imphal at that time, which was perhaps on the basis of some ground features. At 07:09:45 hours UTC i.e. about one minute and one second thereafter, the crew reported to ATC Imphal that they were 12 miles inbound. The above information tend to indicate as if the aircraft had covered a distance of 13 miles in about one minute which is an impossibility. The position report at 07:09:45 was perhaps given on the basis of revised ETA of 07:12

which got effected on account of early commencement of descent and which does not seem to have been taken into account by the flight crew.

The above deviations in the actual flight path followed by the aircraft from the laid down operational flight plan reflect scant respect for laid down operating procedures by the flight crew and evidently lead to unsafe situations during flight. It also shows that the crew did not know exact position of the aircraft during approach to Imphal primarily on account of deviations from the flight plan. This is evident from the fact that at 07:11:29 the flight crew reported that they were approaching overhead Imphal VOR whereas they were actually at that time about 15 nautical miles away from the VOR. Based on their estimated time of arrival of 07:12, which was very much at variance with actual position, the flight crew commenced right turn for direct outbound at 07:11:42 when, in fact, they were still about 14 nautical miles away from the VOR. At 07:12:13 hours UTC the flight crew reported that they were on outbound leg for let down and were descending to 5,000 feet. At that time, the aircraft was still about 10 nautical miles away from the VOR. From the above it is abundantly clear that the crew had no precise idea about their position and coupled with the fact that they did not report overhead VOR, they went far away from the normal ILS path during the let down.

The actual path followed by the aircraft during its approach to Imphal vis-a-vis the ILS let down path may be seen in Annexure 'K'.

In accordance with the ILS let down chart of Imphal Airport, the aircraft is required to descend from 10,000 feet to 8,000 feet in the holding area and then proceed outbound on radial 217 for a duration of two and half minutes from overhead VOR. The aircraft's speed during the outbound leg is restricted to a maximum of 170 knots. In the process of going outbound when the aircraft flies over middle marker and outer marker, it gets audio and visual

signals in the cockpit. During the outbound leg the aircraft should descend from 8,000 feet to 5,000 feet. As mentioned earlier the aircraft did not report overhead VOR and, in fact, commenced right turn when it was about 14 nautical miles away from the VOR and at an altitude of 10,000 feet. While executing turn, the aircraft started descent. On completion of the right turn at about 07:13:06 UTC, the aircraft flew in a direction of 196 to 210° for about 1 minute 35 seconds i.e. upto 07:14:41 UTC and during this period the aircraft descended to an altitude of about 6,880 feet. Thereafter, the aircraft turned left in the form of procedure turn.

From the above it is seen that the outbound leg was totally at variance from the normal outbound leg of an ILS procedure. The aircraft was nowhere on radial of 217, it never came overhead middle marker or outer marker which is apparent from the ground path shown in Annexure 'K' vis-a-vis the ILS path. This fact is also borne out from the CVR transcript which shows that there was no audio signal of middle marker or outer marker recorded on the tape during the outbound leg. The ill-fated aircraft went on the outbound leg for about one minute and thirty-five seconds as against two and a half minutes normally required. The aircraft speed during the outbound leg was between 175 to 180 knots, which was higher than the maximum permissible speed of 170 knots. During the outbound leg the aircraft descended to an altitude of 6,880 feet whereas as per the ILS let down chart it should descend to an altitude of 5,000 feet prior to commencement of procedure turn.

From the CVR tape transcript it is noted that at 07:14:38 UTC there is an intra-cockpit conversation "Two minutes up" indicating as if the crew were timing the outbound leg and at that juncture it had flown for two minutes on the outbound leg though in fact it had flown only one minute and 35 seconds as noted above. Admittedly the aircraft did not come overhead VOR from which the time calculation would have to be made as per the let down chart for a period of two and a half minutes. There is no

evidence on record neither any one of the parties have tried to give any explanation as to the fix from which the time calculation as appears from the CVR transcript was effected. Obviously, the pilots were proceeding on the basis of some fix and upon the expiry of the two minutes have recorded the same as noted above. Capt. Mehta has stated that a pilot in the event of malfunctioning of the VOR instrument would always check through other cockpit panel instruments and as such the possibility of wrong VOR instrument indication having misled the pilot does not arise. The only presumption is that the pilots well knew that they are not following the or adhering to the route chart and in that event probably with some ground fix they have started calculating the time. It is, however, to be noted here that the let down chart in fact, provides for a flight of two and a half minutes on the outbound leg but on the basis of the FDR read-out there is no manner of doubt that the pilots were taking a turn immediately after the intra-cockpit conversation - two minutes up. This curtailment of time corroborates the presumption that the pilot well knew that they are not following the procedure in terms of the ILS let down chart and as such there is no manner of doubt that turning short of VOR on to the right hand side is a deliberate act on the part of the pilot and not by reason of any misleading information as otherwise they would not have even curtailed the two and a half minutes leg to one minute thirty five seconds only and they obviously came to the conclusion that this curtailment of nearly a minute leg on the outbound would bring him exactly on the same position where he is supposed to take the procedure turn in terms of the let down procedure and be able to capture the localiser and glide slope and other ground aids thereafter for landing. This particular attempt, however, on the part of the pilot cannot said to be justified at all since according to Capt. Mehta if a pilot goes directly outbound without reporting overhead VOR, he cannot maintain the correct reference of time from VOR.

It may also be mentioned that at 07:14:39 ATCO had asked the aircraft to intimate its altitude at that time, to which the air-

craft first reported 5,000, 5,900 feet and then on a subsequent query from the ATCO confirmed 5,000 feet. This was evidently not the correct altitude of the aircraft at that time but the crew perhaps reported this altitude as they were expected to be at 5,000 altitude at the end of the outbound leg.

A question arises why the flight crew deviated so much from the laid down ILS let down procedure. The only possible explanation could be that since the aircraft did not come overhead VOR, it had no reference with which it could measure the time of outbound leg, fly on the outbound radial of 217 and getting the outer marker and middle marker signals. Since he did not lose the required 2,000 feet over VOR and did not fly for two and a half minutes on the outbound leg, he was unable to descend to an altitude of 5,000 feet at the end of the outbound leg.

It is also relevant to note that the ATCO had asked the aircraft at 07:11:37 UTC and also at 07:12:19 UTC to give a call while commencing procedure turn. When the ATCO again asked the aircraft at 07:14:48 to give a call commencing procedure turn, it immediately reported that it was in the procedure turn. The FDR data shows that they had just commenced the procedure turn at that time though at a wrong position.

While carrying out ILS let down the aircraft is expected to go to a maximum distance of about 13 nautical miles from VOR. The Meteorological Department of India has informed that on the day of the accident, the upper wind at 10,000 feet altitude at Imphal was about 10 knots in a direction from 120° which is almost a cross wind and would not alter the aircraft position with respect to VOR during the outbound leg or in the procedure turn. It is, however, to be noted here that the aircraft when it commenced its procedure turn, was at a distance of about 17 nautical miles from VOR and during the course of the procedure turn it went to a distance of about 20.5 nautical miles from VOR where it impacted with the hill. Obviously the aircraft was at a position where it should not

have been if the laid down ILS procedure was followed. The main reason as to why the aircraft went out so much away from VOR, is that it did not go overhead VOR and commenced right turn for direct outbound nearly 14 miles away from the VOR and thereafter it could not adhere to the ILS procedure in any manner. As the aircraft was executing procedure turn much away from its normal position, the normal terrains clearance was not available in that area resulting in direct impact with the hill. The weather prevailing at that time in that region was cloudy and it is most likely that the crew could not have seen the hill ahead prior to impact as there is no intra-cockpit conversation indicating any anxiety or emergency during the last phase of the flight. The GPWS warning came 'ON' about six seconds prior to the impact when the aircraft came over the hilly terrain and one of the conditions for triggering GPWS warning, namely, excessive terrain closer rate was met. The CVR transcript and the FDR data do not indicate that the flight crew reacted immediately to the GPWS warning though however, there was a gain of about 40 feet in the aircraft altitude in the final few seconds indicating that perhaps the crew had initiated go around action. The terrain avoidance study carried out at Boeing facilities and the simulator exercises carried out at CTE Hyderabad, however, showed that even if the crew had reacted immediately to the GPWS warning it was not possible for the aircraft to clear the hill ahead. It is however to be noted that the GPWS is not designed to provide a timely warning while approaching a steep hill.

At Imphal whilst the open Court hearing was taking place, one Mr. Irengbam Boyaisingh being the son of one Irengbam Tomboksingh, a passenger who unfortunately died in the crash has stated before the Court that the Tower Control has not given any permission to land to the ill-fated aircraft in spite of the fact that the aircraft wanted such a permission for emergency landing and as a matter of fact the Tower asked the ill-fated aircraft to wait for 10 or 15 minutes. This bit of information Mr. Irengbam Boyaisingh has obtained from the local newspapers and articles and as

such a doubt has crept in as to whether, in fact, there was any delayed clearance of the aircraft by the Control Tower at Imphal which has as a matter of fact extended the outbound leg while carrying out ILS approach. From the CVR transcript it is very clear that at no stage the Air Traffic Controller had asked the aircraft to delay landing nor the commander had sought permission from ATC for landing or any emergency landing. Therefore, the question of ATC delaying the permission to land does not arise neither there was any extension of the outbound leg of the aircraft by reason of delayed permission.

In the premises it can thus safely be concluded that the Pilot has not only deviated from the flight plan but also not followed the ILS let down chart. In order, however, to ascertain as to whether, in fact, this is a singular instance or a regular feature with this particular pilot, this Court directed the Indian Airlines to provide the FDR spools of four earlier flights undertaken by Capt. Halder as the Pilot-in-Command for Calcutta/Imphal route. In pursuance of the above direction, the Indian Airlines did, in fact, provide the Court with the spools and on an examination of the same it appears that the pilot has, in fact, more or less followed the self-same track as has been followed in the instant flight under investigation. It was suggested by both the Indian Airlines as also by the ICPA that on all four occasions the approach was VFR and not a IFR one and as such question of following the same route in a weather condition as of 16th August, 1991, does not arise. I am, however, unable to accept such a contention since there is no evidence on record that thee concerned pilot had sought permission for a VFR approach. The four flight paths indicate more or less the identical situation viz. avoiding overhead Agartala and taking more or less a direct route to Imphal with more or less again the same right turn and then land without coming overhead VOR. It is in evidence by two very experienced pilots as noted above that whether the flight is VFR or IFR, the pilot shall have to come overhead VOR before approaching the runway to land and as a matter of fact the CVR transcript of the ill-fated flight also record at 07:01:59 "Visual or

otherwise we will go overhead 10,000 feet then on the hold clear to 8,000 feet and 070 this will be tear drop entry inbound 217 after that leaving VOR 217 ....". In none of these four cases as also in the instant flight under investigation, the pilot, in fact, has gone overhead VOR Imphal. Capt. Mehta considering the four FDRs and flight data in question of the ill-fated aircraft on 16th August, 1991, has categorically stated that Capt. Halder had been deviating from the laid down procedure and his pattern is almost the same and as a matter of fact he has not carried out the procedure of getting into Imphal. Capt. Mehta further stated that as a pilot they are supposed to follow the pattern which is laid down and for which the pilots are briefed and the route charts are also with them but unfortunately there is no system of knowing the route followed by a particular pilot unless there is a report and without an FDR scrutiny it is not possible to know or ascertain as to the flight path followed by the pilot. It is to be noted also in this context that during the tenure of Capt. Mehta as the Operations Manager, no report has come to him to the effect that the pilot has not followed the route or there is any abnormality in the arrival procedure or exit procedure.

While it is true that both Capt. Mehta and Capt. Rahut in no uncertain terms have stated that the pilot shall have to come overhead VOR for Imphal airport but I am inclined to accept the view of my assessor Shri P. Ashoka that direct visual approach can be permitted in the event of there being favourable weather condition and the runway and the approach path can be sighted with ease provided however, the pilot obtains prior clearance from ATC by reporting runway in sight.

v) **Role of Co-pilot during the flight** :

With the advancement of aviation technology and introduction of fly-by-wire control system, the role of Co-pilots has become increasingly important in the present age. Co-pilot is not supposed to be a mere passive and mute spectator in the cockpit but has a definite role to play in the matter of safe flying of the aircraft.

The training programme of the operator (Indian Airlines) also recognises such importance and by reason wherefor co-pilots are trained in the same manner as the Pilot-in-Command. Capt. M.V.V Rao being the Operations Manager, Training, at CTE, Hyderabad, in no uncertain terms stated that the co-pilot should be able to meet all emergencies - the difference however being between the Pilot and the Co-pilot is that while the former will be more proficient the latter by reason of his lesser experience, may not be that proficient.

Capt. M.V.V. Rao has also stated that it is one of the primary duties of the Co-pilot to give corrective advice to his Pilot-in-Command and in the event of his failure to give such corrective advice, his efficiency cannot but be doubted. Capt. Rao has gone on further to state that if the Pilot-in-Command makes a mistake, it should not go unnoticed by his Co-pilot and as a matter of fact both the Pilot and co-pilot should work as a team so that there is no safety hazard. It is the definite evidence of Capt. Rao that in the event of deviations by the Captain, the co-pilot should caution him and failure to administer such caution can be termed to be an act of indiscipline and if it comes to light, steps would be taken against the concerned Co-pilot. It is also the duty of the Co-pilot to inform the management in the event of his experiencing any deviations on the part of the Pilot-in-Command and as a matter of fact there are some such instances, since Co-pilot is always aware of the actions of the Pilot-in-Command during the course of the flight.

Incidentally it is to be noted that in the instant investigation, a perusal of Cockpit Voice Recorder transmission does not show any word of caution or any correction to the deviations of the Pilot-in-Command by the Co-pilot. As a matter of fact, the Co-pilot was as much a party to the deviations as the Pilot-in-Command - admittedly the flight crew were working as a team and both of them were, therefore, deviating from the normal procedure as depicted in the operational flight plan as also the ILS let down chart. Equal indiscipline and lack of professionalism, therefore, can be ascribed so far as the Co-pilot is also concerned.

It is not out of place to record that the Operations Manual of Indian Airlines provide that the Co-pilot should monitor the instrument approach and it is especially important that the Co-pilot will automatically inform the Pilot-in-Command of any abnormal deviations from the approach procedure, altitude, rate of descent, speed and timings. As a matter of fact, the Operations Manual provides that Co-pilot during the approach acts as a safety pilot and ought not to hesitate to inform the Pilot-in-Command of any abnormality or procedural discrepancy.

Considering the flight in question (IC-257), the deviations right after Comilla continued till upto the crash point - not reporting overhead VOR Agartala and following an unspecified route from overhead Comilla, starting of the descent too early contrary to the operational flight plan; not reporting overhead VOR Imphal; turning right much short of VOR at Imphal; wrong altitude call-outs at different locations, have all been accepted by the Co-pilot without any caution or even an advice. This indicates that the Co-pilot did not perform his duty as was expected of him in terms of the Operations Manual of Indian Airlines.

vi) **Possibility of wrong Indication by VOR**

During the course of investigation of this accident and at the open hearings the operator raised doubt in regard to the malfunctioning of the VOR being one of the navigational aid at the Imphal Airport. It was submitted that the Pilot-in-Command has initiated a right turn before coming overhead VOR, may be by reason of a false indication of the VOR. Capt. Mehta, however, in no uncertain terms has negatived that suggestion. In this context, particular reference may be had to question No.194 and its answer given by Capt. Mehta. The question as above together with the answer is set out hereinbelow :-

"Q.194 : So, if you get a false indication on your VOR that can easily be checked with the help of other available

instrument on the cockpit itself? / Yes, cockpit has no problem to differentiate false signals".

Capt. Mehta clarified that mal-functioning of VOR can easily be checked in reference to other front panel instruments. He stated that it is a standard procedure that as soon as the flag comes in view on the instrument, the pilots check it with other instruments. He stated that question of being misguided by reason of false VOR indication does not and cannot arise. Furthermore, in the normal course of events, in the event of any difficulty being experienced by the pilot by reason of mal-functioning of anyone of the cockpit instruments including VOR, there would have been some discussions amongst the pilots and also a subsequent transmission in regard thereto to the Air Traffic controller. On a perusal of the CVR transcript, no such inconvenience has been discussed or transmitted to the ATCO. In fine, therefore, it can safely be concluded that question of there being any mal-functioning of any panel instruments which could have mislead the Pilot-in-Command does not and cannot arise.

Incidentally it is to be noted that on the fateful day two other flights of Indian Airlines, namely, IC-890 from Delhi to Imphal was operated by an Airbus A-320 aircraft and IC-255 from Calcutta to Imphal operated by a Boeing 737 aircraft did, in fact, use all the ground aids without any inconvenience whatsoever. The Commander of IC-255 (Capt. K. Patel) in his statement dated 22nd August, 1991, stated that all the navigational aids at Imphal were serviceable and were working normally. Capt. L.P. Mishra, who operated the flight IC-890 has also confirmed such a state of affairs in regard to the navigational aids at Imphal Airport.

It is to be further noted that the VOR was calibrated by the National Airports Authority aircraft by carrying out flight tests on 4th June, 1991 and its operational status was declared unrestricted. Immediately after the accident, the Director General of Civil Aviation ordered special flight check of the VOR and other ground

aids, in pursuance whereof the ground aids at Imphal were calibrated on 18th August, 1991, with a DGCA representative for the purpose of ascertaining as to whether the facilities at Imphal were in normal working condition. The flight test ensured that all parameters of VOR were within the specified limits. In this context, reference may be made to Annexure 'G' to this report wherein it has been stated - "All parameters have been found to be within defined limits. VOR let down procedure checked and found that the indications were satisfactory and flyable".

Scrutiny of the maintenance records of Imphal VOR indicated that maintenance personnel have been taking periodic meter readings of the VOR equipment as well as undertaking monthly ground checks. The last fault as recorded in the Fault Log Book of the VOR occurred on 9th June, 1991, which was attended to and rectified on the self same day. Thereafter, no fault has been recorded for this particular facility (VOR) at Imphal Airport.

In the premises, in my view, it can safely be concluded that question of there being any false indication of VOR does not arise neither there is any scope for the pilot being misled by reason of a false indication.

vii) **GPWS warning and Crew action** :

CVR recordings have shown that GPWS warning had triggered about six seconds prior to the impact of the aircraft with the hill. The FDR Data indicates that the aircraft was descending till the time GPWS warning had come ON and thereafter the aircraft almost levelled off and it had started gaining height thereafter indicating as if the Commander had initiated action to climb up.

The evidence available shows that the aircraft impacted the hill at an altitude of about 5200 feet and the maximum height of the hill at the point of impact is about 5500 feet indicating thereby that the aircraft impacted about 300 feet below the peak of the hill.

A question arose whether the aircraft could have cleared the hill if action was initiated by the Pilot to 'Go-around' immediately when the GPWS warning had come 'ON'. In order to examine this aspect, simulator flights were carried out on B-737 simulator of Indian Airlines at CTE Hyderabad using the CVR and FDR Data. During the simulator flights the aircraft speed was maintained around 180 kts. which was the speed at which the aircraft had impacted. Since the aircraft was turning at an average rate of about 3 degrees per second during the period when GPWS warning was 'ON', corresponding 30 degree aircraft bank was maintained during the simulator flight. As per the CVR read out the crew had taken the Flaps to position 1. During the procedure turn generally Flaps are at position 5. The simulator flights were, therefore, carried out for both Flap 1 and Flap 5 positions.

The simulator flights were carried out by Capt. DeCosta, a B-737 Examiner along with Capt. R.I. Singh under the supervision of Capt. Thergaonker. These flights were conducted in the presence of the Court, DGCA, Dy. DGCA and Director of Air Safety. From the simulator flights, it was observed that even if immediate action was taken to pull up the aircraft and engine throttles moved forward immediately when the GPWS warning had come 'ON', the aircraft could gain a height of 100 to 110 feet with Flaps 1 and Flaps 5 respectively. It, therefore, indicates that even if the crew had initiated immediate 'Go-around' when the warning came 'ON' the aircraft could not have cleared the hill.

Since the issue pertain to the pilot's reaction and has thus a serious effect on the training aspect, I directed the Deputy Director General of Civil Aviation, Government of India, to have a simulator exercise being done at the manufacturers end for terrain avoidance. In accordance therewith, all necessary details were sent to the manufacturers, and in fact, one Mr. James Kerrigen, an Aeronautical Engineer of the Boeing Company from Seattle, Washington D.C. appeared before the Court of Inquiry as a witness with all

necessary evidence including the computerised graph for the simulator exercise in regard to terrain avoidance. Mr. Kerrigen stated that with a moderate human approach to the signal from GPWS, the pilot could not have cleared the terrain. Since taking the pilot's reaction into consideration, the climb rate would be around 90 feet per second after obtaining full throttle power and to achieve full throttle power, the aircraft takes about 3.5 seconds. In answer to a pointed question as to whether the climb rate would be greater after attainment of climb rate of first 90 feet per second, Mr. Kerrigen stated that it would be again in the region of 90 feet per second though there might be slight variation by reason of flap position being flap 1 and flap 5, though however, variation would be extremely negligible. It is to be noted, however, that originally the simulation at the manufacturers end was carried out on 'Nil Wind' basis, but at the request of the Court special messages were sent to the Boeing Company by Mr. Kerrigen for drawing out the flight path on the basis of 10 and 20 knots of tail wind on the outbound leg and Mr. kerrigen also produced the fax in regard thereto, which however, does not show much of a difference in the ground path by reason of the existence of the tail wind as above. The study of the Boeing Company is already an annexure to this report being Annexure 'F'.

Though the aforesaid study indicates that 'Go-round' action by crew after the warning had come 'ON' would not have prevented the accident, importance of immediate crew action whenever GPWS warning comes 'ON' cannot be over-emphasised. When the aircraft is flying in IMC conditions, the crew is not in a position to determine how close they are with the terrain and hence, immediate action when GPWS warning comes 'ON' could save collision of aircraft with terrain. Even when the aircraft is flying in VMC conditions and crew may see the terrain the warning should not be ignored since the aircraft may not be in a safe configuration to land i.e. the Landing Gear may not be extended, flaps may not be in landing configuration or the deviation from the ILS Glide Path may be excessive. Even if crew could visually see that there is no

danger of collision with terrain, it is necessary to take immediate action to check the aircraft configuration whenever GPWS warning comes 'ON'. While Indian Airlines have informed that their training procedures require that GPWS warning should not be ignored and immediate action should be taken, it is absolutely essential that the drill of taking immediate action to 'Go-around' in IMC condition and to check the aircraft configuration in VMC condition should be rigorously practiced during the training and subsequent refresher/ proficiency training and checks. The Airline should monitor this aspect very closely so that crew react to the warning without loss of time which is very crucial in such situations.

14. INCIDENTAL ISSUES

During the course of hearing, certain incidental issues were raised, which in my view, needs consideration. The same are for convenience sake tabulated hereinbelow :-

1. Training :-

   a) Pilots/Co-pilots
   b) ATCOs
   c) Electronic/Technical Officers
   d) Cabin Crew

2. Frequent flying on one route by the pilots.

3. Pre-flight medical check of crew.

4. Search & Rescue.

5. Accident Prevention Cell.

6. Control Tower Equipments :-

   a) ATC Tape;
   b) Status Indicator lights.
   c) RVR indications.

7. Implementation of earlier recommendations.

8. Operator's Flight Safety Directorate.

9. Present system of accident investigation.

10. Regulatory functions of DGCA.

11. Formation of an Air Safety Board.

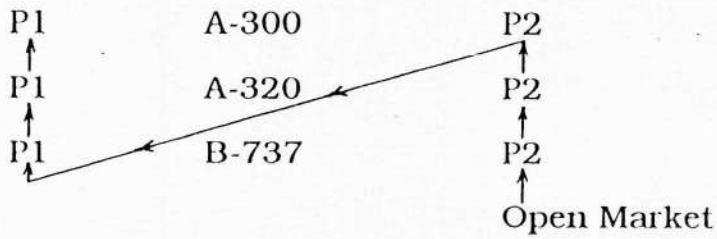
It would, however, be convenient to deal with the above issues at this juncture seriatim :

14.1 **Training** :

14.1 (a) **Pilots and Co-pilots** :

On the safety aspect training of Pilots is of prime importance. Capt. M.V.V. Rao, being the Operations Manager, Indian Airlines, Central Training Establishment, Hyderabad, has stated before this Court as to the method and mode of training of pilots in the manner following :

"In accordance with the existing system, Trainee Pilots recruited from the outside market are trained as Co-Pilots on B-737. Their career progression in Indian Airlines is as per the following career pattern.



Training imparted at different stages is as follows :

1) Co-pilot on B-737

(Arrives C.T.E. as Trainee Pilot with C.P.L. - flying experience 250 to 300 hours invariably on Single Engine).

a)	Basic Technical/Performance	-	2 Weeks
b)	B-737 Technical Endorsement (Including Specific Performance).	-	6 Weeks
c)	B-737 Examination (Technical & Performance conducted by DGCA)		
d)	Training in Navigation Subjects	-	6 Weeks

		*P.F.	@P.N.F.
e)	Simulator Training (Basic)	20:00	20:00 hrs.

f)	Simulator Training (Endorsement)	20:00	20:00 hrs.
g)	simulator Check (with DGCA approved Examiner)	01:30	01:30 hrs.
h)	Circuits/Landings on B-737 simulator prior to commencement of flying training.	06:00	06:00 hrs.
i)	Flying Training on aircraft	10:00	10:00 hrs. (Observer)
j)	CA40A Day and Night Checks/ IR-LR Checks with DGCA approved Examiner.	02:00	- hrs.
k)	Supernumerary Flying on B-737 aircraft (Minimum).	125 hrs Per Pilot	

l) Obtains Type Endorsement Rating and IR Issue/ Renewal from DGCA.

m) Release as Second Officer - 3 Satisfactory Route Checks with DGCA approved Instructor/Examiner.

n) Release as First Officer - One Satisfactory Route Check with DGCA approved Examiner.

After release as First Officer he is posted to one of the four Regions depending on operational requirement.

Undergoes Supernumerary Flying as first Officer followed by LOFT with one Check Pilot/Instructor as far as possible. LOFT - minimum of 15 flights or 50 hours whichever is more. During LOFT as many non-precision approaches as possible are to be carried out subject to a minimum of five.

* PF - Pilot Flying
@ PNF - Pilot not Flying

2) <u>PIC Training on B-737</u>

(Licence Qualification - A L T P)

i) If a Pilot is taken from B-737 type of aircraft, he is taken up for PIC training straight away.

ii) If a Pilot is taken from an aircraft other than B-737, he will undergo the following additional training, before PIC training:

a)	Reconversion Training - Extended Refresher (Technical/Performance)	One Week

		*PF	@PNF
b)	Simulator Training	20:00	20:00 hrs.
c)	IR/LR Check on Simulator	01:30	01:30 hrs.

d) Route Checks - Minimum 5, of which the last two with separate Examiners before release to fly as Co-pilot.

After acquiring adequate recency experience on the type (Minimum - 100 hrs), he is taken up for Command Training.

PIC Training

		*PF	@PNF
a)	PIC Simulator Training	18:00	18:00 hrs.
b)	PIC Check on Simulator with DGCA approved Examiner.	01:30	01:30 hrs.
c)	Circuits/Landings on Simulator.	08:00	08:00 hrs.
d)	CA40B Day and Night Checks on aircraft with different DGCA approved Examiners.	03:00 hrs Per Pilot	
e)	PIC LOFT on aircraft with a Flying Instructor prior to commencement of PIC Route Checks.	15 flights maximum Per Pilot	

In case required, additional LOFT is sanctioned.

f) PIC Route Check - 10 Consecutive Satisfactory Route Checks (of which at least 5 by Night) with at least 3 different Check Pilots. The 9th and 10th Route Check by Day and Night each carried out by separate DGCA approved Examiners nominated by C.T.E.

g) Obtains PIC Rating from D.G.C.A.

h) PIC Release route Check - One Satisfactory Release Route Check with an Examiner prior to release to fly in command.

i) Route Check after flying 100 hours of PIC - One Satisfactory Route Check with an Instructor/Examiner to assess consistency.

j) Monsoon Route Checks:

1) First Attempt PIC - 3 Satisfactory Route Checks with Instructor/Examiner under actual monsoon conditions for non-precision and precision approaches covering short airfields.

2) Second Attempt PIC - 5 Satisfactory Route Checks with Instructor/Examiner under actual monsoon conditions for non-precision and precision approaches covering short airfields".

While it is true that the method and mode of training seem to be rather rigorous and according to Capt. M.V.V. Rao in accordance with other global standard, but I have certain reservations in regard to the career pattern of pilots in Indian Airlines. It is noticed that young boys are recruited from open market and after training they operate the flight as Co-pilot (P-2) in B-737 aircraft from where, however, the same man progresses as Co-pilot on A-320 aircraft and finally as Co-pilot on A-300 aircraft. Surprisingly, however, in terms of career pattern followed by Indian Airlines as regards command endorsement it is only P-2 in A-300 who gets a command endorsement as P-1 in B-737 and progressively as Pilot-in-Command in A-320 and thereafter on A-300. This particular career pattern cannot in my view stand to any reason whatsoever since from the conventional type (B-737) one is taken to fly-by-wire glass cockpit as a Co-pilot and thereafter again transmitted to a conventional aircraft (A-300) and finally transmitted back as Pilot-in-Command in the conventional B-737 and thereafter from conventional to glass cockpit and then again to conventional aircraft. It seems before drawing out this career pattern there was no strict application of mind so far as the operator (Indian Airlines) is concerned otherwise there would not have been a shift from conventional to glass cockpit and from glass cockpit to conventional aircraft on more than one occasion in the career of a particular individual while acting as a Co-pilot and a Pilot-in-Command. In my considered opinion this cannot be termed to be a very safe career pattern and if this particular career pattern is continued I have no hesitation to record that there will be nothing but a compromise with the safety of air passengers. Time has now come

up, therefore, for the operator to restructure the whole career pattern of the pilots so as to be in conformity with the safety norms as is prevalent throughout the globe. It is to be noted, however, that A-320 pilots (P-1 or P-2) do not fly any other aircraft in actuality.

On the basis of available evidence, however, as regards Capt. Halder's proficiency, I find that his Boeing 737 endorsement training was first taken up by Capt. M.S. Sharma, but after about 2 hours and 15 minutes of simulator sorties, Capt. Sharma did not find Capt. Halder to be suitable enough for undergoing the training and he discontinued his training thereafter. Capt. M.V.V. Rao upon proper scrutiny of the records maintained by the Indian Airlines training institute, has stated that since Capt. Halder was doing hard landings, Capt. Sharma discontinued his training. According to Capt. Rao, this discontinuance may be due to communication gap between the trainee and the instructor or Capt. Halder's performance being not upto the expected standards, though however, there is no evidence available on this score and the statement as above admittedly was purely on guess work of Capt. Rao. Incidentally it is to be noted that after Capt. Sharma discontinued with the training, Capt. Rahut was entrusted for training of Capt. Halder for Boeing endorsement wherein after 15 days Capt. Rahut found him fit for endorsement. It is not out of context to note here, however, that Capt. Rahut also informed that during his 15 days training, he found Capt. Halder coming high on approach on turn which he corrected after five or six landings including the corrections of the deficiencies reported by Capt. Sharma.

On the basis of above, it therefore, appears that both Capt. Sharma and Capt. Rahut found him deficient at the first stages on two specific counts and as such a doubt creeps in my mind as to whether Capt. Halder should have been cleared for Boeing 737 endorsement without being taken up for further training so as to give him more experience or not. The trainer apparently felt that

there is no deficiency in Capt. Halder. It is on this count that I wish to put on record that training even as per the procedure as noted above ought to be in strict accordance therewith and there ought not to be any laxity or any compromise with such a training to a pilot. It is true that Capt. Sharma did not record that Capt. Halder needs further experience before obtaining Boeing 737 endorsement, but omission to record the same ought not to be taken note of as his assent to a new instructor to obtain Boeing 737 endorsement training.

In this perspective, therefore, I would like to record my observations that in the event of any deficiency being noticed by the trainer, instead of changing the trainer further experience ought to be given to the pilot concerned so that when he takes up the course for endorsement, there cannot be any deficiency in the pilot concerned. Let it be clarified that I am not trying to impute any deficiency in Capt. Halder, but the system ought to be such so as to obviate such deficiencies during the endorsement training course. This observation of mine is based mainly on the evidence of Capt. Rao that in the normal course of events one instructor is attached to one trainee unless the instructor is not available for continuation of such training.

It is at this juncture that my visit to Australia and Singapore seems to be well-worth. The training standards set up by the operator (Indian Airlines) and the Director General of Civil Aviation cannot be termed to be different or deficient in any way from that of the Qantas or Singapore Airlines training programme. As a matter of fact, the training programme in our country is as rigorous as that of the other two countries but the system of training is the sphere where we need focus our attention. Qantas Airlines has evolved a course intituled "Cockpit Resource Management Course" (CRM). In the introduction to the CRM course, it is stated - "perhaps the first, and most identifiable element in Cockpit Resource Management training is that of using the available resources in decision making. One purpose of the CRM course is to

overcome a basic weakness that initial training has bred into pilots. Pilots have been taught to fly aircraft as sole crew members. CRM will teach us to use all the resources at our disposal to gather information, review the information, analyse that information, develop solutions, implement the decision and evaluate the performance as an ongoing process of education.

Another part of CRM training is understanding communication. We will learn how to communicate with other people effectively. We will learn how other people react to certain styles of communication. We will learn which styles of communication produce the best results in specific situations. We will learn about communication without speaking. We will learn to listen.

As part of the understanding of communication, we will learn about ourselves and how others relate to our style. We will learn to analyse our own personalities and recognise our own strengths and weaknesses. We will learn when to be assertive and when to be supportive and we will learn to recognise and avoid using aggressive behaviour and to see the fine line between the supportive and the submissive.

We will learn how to properly assess the priorities and channel the team effort toward effective accomplishment of the prime task."

According to Qantas it is not a training department plot to impose another series of discussion items for licence renewal. The course will have no examination or tests and the ongoing training will not involve CRM test, the command prorogative will be maintained. The object is to assist the Captain to come to the best decision and to train his crew to be useful to their captain in this decision making process. The training is designed to teach them when to speak, how to speak and if it is absolutely necessary where not to take 'no' for an answer. The idea is to practice CRM and then to discuss the collective performance at a debriefing at

which the instructor is little more than the master of ceremonies. To aid in the debriefing, the simulators are fitted with video cameras and matters of interest will be played back to the crew by the instructor in the briefing room. The debriefing will consist of the instructor leading a discussion whereas the crew evaluate their own performance aided by the video play-backs. This CRM course consists of various factors, namely, (i) Decision process; (ii) Situational factors affecting decision making; (iii) Behavioural decisions; (iv) Communications attitude; (v) Leadership; (vi) The team works. This CRM provides a better opportunity and an understanding of the whole situation which would otherwise be not available to a flight crew while operating a flight.

Unfortunately, not an iota of evidence is available on record before this Court of Inquiry in regard to this particular course of Cockpit Resource Management so far as the Indian Airlines is concerned. I have, however, learnt that some time back this particular course was in fact introduced by Indian Airlines, but for some reason or other the same was abandoned. Having experienced the necessity of such a course in Australia, I have no manner of doubt its utility vis-a-vis the safety of air passengers. The video play-back has a tremendous effect on human psychology more so when the person viewing it, is a pilot. Nobody need tell him about the draw-backs, if there be any, since one can realise his own mistake through observation by himself and the operator would be well-advised to introduce such a course for the purpose of an effective cockpit management during the course of a flight.

As regards the Civil Aviation Authority, it is noticed in Australia that there is no active participation of the regulatory authority, but its functions are restricted to supervisory nature since the entire safety aspect of an air travel is dealt with in an elaborate fashion by the operator itself and the examples are galore.

As regards the proficiency checks, the CAA Australia requires the pilots to have the same checks twice a year but the

operator, namely, the Qantas Airways does the same checks themselves four times a year - this by itself depicts the sincerity of the operator in the matter of safe flying.

As regards the check pilots, it is the operator (Qantas Airways) who nominates the check pilots upon completion of the check pilots course and the Civil Aviation Authority Australia grants necessary certification in regard thereto after the nominated check-pilot is checked by their examiner. The CAA also monitors the actions of the check pilots and if the latter do not conform to the flight standards, the check pilot's authority to act as such is withdrawn forthwith.

As regards the initial training, it appears that the standard of pilots proficiency is carefully controlled by proper selection at the initial stage. Qantas carry out psychological tests and aptitude tests for proper coordination and reaction in a given situation. The ab-initio pilots are selected at an age of 19 years and it is the Qantas who send them for training to an approved training school for which a substantial amount of money is to be paid to the training schools by the Qantas itself for carrying out ab-initio training, though, however, the remaining cost would be borne by the trainee himself. The flying training at the training school is completed in a duration of about 16 months and on completion of which the trainees acquire Commercial Pilots' Licence. Thereafter, the trainee undergoes 8 months training with Qantas on a particular type of aircraft, thus, in about 2 years time from the start of ab-initio training, the trainees become second officers. It takes about 5 years approximately to be a first officer from the rank of second officer and thereafter on the basis of the seniority and on the usual command training and checks the first officer obtains Pilot-in-Command endorsement. The Flight Operation Standards pilots about 5 in number, carry out surveillance checks of about one per cent of the sectors which is about 25 sectors per month. The surveillance and monitoring is now being gradually delegated by the Civil Aviation Authority to the airline Flight Operations Stand-

ards. The Flight Operations Standards pilots monitor the standard of individual pilots - they check the check pilots, inspect the simulators and training institutes and maintain data base of pilots.

As noted above, though the CAA requires that proficiency checks of pilots be carried out at least twice every year. Qantas carries out such checks every three months and every pilot goes through simulator exercise every three months. A report is prepared every time and the assessment is kept in the computer and retrieved for review whenever the pilot goes for promotional training or is appointed as a check captain. If during a simulator check, a pilot fails, he is taken off flying immediately till he passes the checks. The general trend of the proficiency of the pilots is retrieved from the computer data which may show any deficiency in the training system if it prevails. Such monitoring reduces the failure rates and hence saves training costs. The nil accident rate of Qantas has helped them in reducing the insurance cost and has improved the passenger confidence as a result of which they get higher share of passenger traffic. While appointing check pilots, the computer data of the pilot is scrutinised by the Flight Standards branch and it is only thereafter a pilot is taken for training as a check pilot. After successful completion of checks by the Flight Standards pilots, the name of the pilot is recommended to CAA for approval.

One of the most important feature of monitoring and surveillance by Qantas is monitoring of Quick Access Recorder (QAR). They monitor the data of every flight with the help of computer system and analyse the 50 selected parameters to find out if there exists any deviation from the limit values. If there is a general trend of exceedence of any particular parameter the training division is immediately informed to find out if there is any deficiency in the training. On implementation of remedial measures they have been able to drastically reduce the deviation rates. The QAR analysis has been established with the concurrence of pilots' Union on the condition that the name of the

crew will not be divulged and any deviation observed during the analysis will be told to the Union for taking necessary measures to eliminate the same. The Qantas do not take any direct action and it is left to the Unions. They have found the system working satisfactorily as according to them the Unions and the individual pilots are made more responsible to ensure that no deviations from the laid down procedures occur.

During the training of pilots in the simulator, they make the video tapes which they show subsequently to the pilots so that they become aware of any deficiencies during their simulator training.

Any personality traits of pilots are not allowed to affect airline operations. Even if a pilot passes every proficiency test but if his personality can cause difficulty in airline operations, he is not given command endorsement and he is kept only as a first officer.

In the introduction chapter of this report, I have already delved into the role of Executive Pilots in Australia. It is not also out of place to note that the Executive Pilots are allowed to fly by Qantas only about 1/3rd of the flying done by the line pilots. In order that these pilots do not suffer financially, they are kept on fixed salary independent of the hours flown by them. In this way, a proper balance is maintained. The minimum flying required to be done by the executive pilots so as to maintain surveillance and to have a feel of the operations and also provides enough time to them to devote on the aspects of planning and monitoring the training and operational aspects. In this way, the executive pilots maintain very close watch on day-to-day operations and can devote enough time in office to handle the operational matters.

Singapore Airlines is also one of the safest airlines in the world. There has been no accident to Singapore Airlines during the last 30 years. The training programme of Singapore airline is quite similar to the programmes in India and Australia. The opera-

tor prepares the training programme of pilots and submits the same to CAA for approval. During the training on simulator, the aircraft flight path is plotted by computer and if a pilot is found not reacting urgently in an emergency, the instructor would repeat the exercise. On operators aircraft, the CAA flight inspectors check the check-pilots and examiners of Singapore Airlines. The flight inspectors carry out checks of the examiners and the check pilots once in about two months. The airline examiners check the proficiency of pilots and the CAA ensures that the laid down system works and they only do sample checks.

The airline decides on which type of aircraft a pilot will go for training and there is no choice of a pilot to decide which aircraft he would go for training. A CPL holder becomes first officer after about eight months training with the airline. During the training he can go as a second officer and acts as a supernumary pilot. Before a Co-pilot can become a Pilot-in-Command, he should get ALTP and acquire about 5,000 hours experience as a Co-pilot. Thus, a Co-pilot would become a Pilot-in-command after about 10 years.

A pilot can fly only one type of aircraft at a time. Pilots holding command endorsements on basic B-747-200 or 300 aircraft cannot fly B-747-400 aircraft. Only check pilots and examiners can fly two types of aircraft. Even cabin crew can fly only on two types of aircraft.

The simulator training is imparted by instructors who are current on the type. Only recurrent training can be given by retired pilots who are appointed on ad hoc basis. Singapore Airlines requires proficiency checks of pilots on simulator to be done at every three months.

From the study of the training and proficiency monitoring of pilots by Qantas and Singapore Airlines, it is noted that the airline systems are well laid down, followed and monitored. It is the

airlines which takes responsibility to ensure compliance of the laid down procedures. The CAA is there to carry out random checks. The culture in the airline is so safety conscious that one cannot think that there would be any deviation from the laid down procedures. The pilots and the associations are made responsible to remove deficiencies observed during the monitoring. The airline, let alone the CAA, does not have to resort to punitive actions to enforce compliance of the operating procedures. Such a culture needs to be developed, if we have to take a major step forward towards the safety of aircraft operations. All concerned whether an individual pilot, pilots associations, the executive pilots, the management of the airlines and the regulatory authorities have to re-orient and restructure their policies and programmes to cultivate a healthy atmosphere, the spirit of team work and collective sharing of the responsibilities.

The other aspect of the training to pilots in the matter of terrain avoidance in our country ought also to be emphasised. It is to be noted that the Aviation Research and Education Foundation of the United States of America recommended to the Federal Aviation Authority in the context of Delayed GPWS Response Syndrome the following :

"- emphasize that the only acceptable procedure for reacting to a GPWS pull-up warning of impending impact with the ground is to immediately set maximum thrust and rotate to the pitch angle for maximum angle of climb;

- specify that daylight visual observation is the only acceptable means for contradicting such a GPWS pull-up warning for terrain closure;

- ensure that the airplane flight manuals and training curricula of all GPWS equipped U.S airlines prescribe the aforementioned procedures for dealing with a terrain-closure GPWS pull-up warning;

- require that GPWS equipped U.S. carriers include a terrain closure GPWS pull-up warning in all initial and recurrent simulator training sessions;

- set a deadline for upgrading all first-generation GPWS equipment to the current state of the art; and

- ensure that the minimum terrain clearance standards used by GPWS are compatible with those used in establishing minimum altitudes for radar vectors and for approach charts."

Subsequently, however, National Transportation Safety Board of USA also in the line as above recommended that "FAA should instruct all air carriers to include in their flightcrew procedures instructions which require an immediate response to the ground proximity system's terrain closure "pull-up" warning when proximity to the terrain cannot be verified instantly by visual observation. The required response to this warning should be that the maximum available thrust be applied and that the aircraft be rotated to achieve the best angle of climb without delay."

After considerable deliberation, the Federal Aviation Administration, USA, also responded to the need of the hour and implemented the recommendations.

Both in Australia and in Singapore, the pilots are trained to react immediately with the triggering of the Ground Proximity Warning System. In Australia, during training of pilots for command endorsements, random GPWS warning is injected on to the computer at the simulator and the pilot's reaction is noted by the computer. Such a reaction thereafter is scrutinised and if thought fit, further training is imparted on to the pilot in regard thereto. The importance of adhering to GPWS is made known to the Pilot-in-Command. Similar is the situation in Singapore.

It is heartening to note also the Director General of Civil Aviation in his anxiety in regard to this particular branch of Air Safety issued an Air Safety Circular in January, 1992 to the following effect :-

SUBJECT: ***<u>GROUND PROXIMITY WARNING SYSTEM RESPONSE</u>***

In the last two decades, the world over, it has been noticed that there is a tendency on the part of the pilots to ignore Ground Proximity Warning resulting in avoidable accidents. It has been the cause of worry and

concern amongst the Civil Aviation Authorities the world over. Circulars have been issued by FAA as early as 1981 in regard to procedures to be followed when a ground proximity warning is sounded in the cockpit of the aircraft.

2. *Pilots have a tendency to ignore ground proximity warning, based on their experience of false triggering of this alarm. When they had responded to the alarm in other causes, it had been too late. In India also, it has also been observed in a few cases, that pilots have ignored Ground Proximity Warning with disastrous consequences.*

3. *It is, therefore, hereby ordered that the following procedures may be followed by all pilots :*

   i) *In regard to terrain closure "pull up" alarm when the pilot has no accurate visual observation as a basis for contradicting it, the moment the alarm is sounded, the pilot may execute corrective action by immediate application of maximum available thrust while simultaneously rotating the airplane to achieve the best angle of climb. The rate of rotation must be consistent with the existing flight parameters of the aircraft concerned so as not to exceed the critical angle of attack.*

   ii) *Pilots should not inhibit GPWS warning system unless there is positive contra indications by accurate visual observation.*

   iii) *Air carriers should review their operations manuals to incorporate appropriate flight crew training procedures to train pilots for action with respect to GPWS signals. The airline carriers may incorporate even in the training programmes appropriate routines for training, to respond to GPWS alarm. They should also test the pilots to such GPWS response during checks, trainings and other routine exercises which they are required to carry out in the simulator from time to time.*

   iv) *Airlines may immediately carry out a check of all the GPWS equipment on the aircraft to ensure their integrity and proper serviceability to eliminate false alarm.*

4. Action taken by the Airlines in compliance of this directive that :

(a) they have brought this circular to the notice of all their flying crews;

(b) they have incorporated suitable provisions in their operations manuals; and

(c) they have issued appropriate direction to the Training Establishments for the training procedures required in this regard.

be reported to the DGCA by 25.1.1992.

Sd/-
(M.R. Sivaraman)
AS & D.G.C.A.
10.1.1992

1. CMD, Indian Airlines (Shri P.K. Banerjee)
2. CMD, Vayudoot (Capt. Trehan)
3. Chairman, Air India (Shri Yogesh Deveshwar)
4. All Air Taxi Operators.

From the records produced before this Court, it appears that the copy of the Circular was duly sent to all the Civil Aviation Operators operating in this country and the operators including the Indian Airlines did in fact respond to the same confirming having taken the action in terms therewith. As regards the confirmation of Indian Airlines is concerned, the same is quoted hereinbelow:

"We confirm having taken the action as under :

(a) The circular has been brought to the notice of flying crew through our Regional Operations Manager.

(b) The circular is being incorporated as Appendix I to para 8.5.0 page 8.26 of IA Operations Manual Vol.I.

(c) Director of Training, CTE, Hyderabad has been advised for taking suitable action vide our letter No.HOP/23-7863/5232 dated 20th January, 1992."

I am, however, constrained to note here that even though the Operations Manager (Training), was available in the witness box, the implementation by the Director of Training in regard to the circular issued by the Director General of Civil Aviation has not been placed on record and as matter of fact on a pointed question from the Court, the Operations Manager simply stated that their training procedures require that GPWS warning should not be ignored and immediate action should be taken. While theoretically this may seem to be otherwise in accordance with the circular, but there is some amount of difference between the theory and the actual practical training course. No evidence whatsoever is available on record to show the introduction of a curriculum in regard to the pilot's action on the triggering of the GPWS, neither their training manual or a syllabus in regard to has been produced before the Court - this state of affairs cannot be stated to be very encouraging.

In my view, it is high time that due importance be attached to the triggering of GPWS. The drill of taking immediate action to go round in IMC condition and to check the aircraft configuration should be rigorously practiced during the training. Proper syllabus be prepared in regard thereto and the instructors be directed to treat this particular aspect as an independent subject of their training and the proficiency checks should also take note of pilot's reaction to the triggering of GPWS.

14.1 (b) **Air Traffic Control Officers** :

The personnel of the aerodrome discipline of National Airports Authority are being recruited from the colleges at two levels, viz. those of Aerodrome Assistants and Aerodrome Officers. The entry qualification of Aerodrome Assistants is degree in Science or

Diploma in Engineering and that for the Aerodrome Officers is degree in Science or a graduation in engineering or a holder of Commercial Pilot's Licence. I have been given to understand, however, that many of the officers recruits are also Post Graduate degree holders in science.

Re Training Programme for personnel recruited at Assistants level :

Ab-initio Training :

Duration	:	4 months.
Subjects Taught	:	Basic Concepts of Aerodrome Control, Theory and Practice including handling of normal traffic density situations, and a few emergencies.
		Other allied subjects such as Meteorology, Air Navigation, Communication Procedures, Navigational Aids, Aerodrome and Ground Aids, Fire Fighting and Rescue, Airframe and Engines, Air Law, and Morse Reception.
		All the subjects are taught only to a basic level at this stage.

On successful completion of the training, the candidate is posted as an Aerodrome Assistant at one of the stations, where he mainly assists the Officers in performance of ATC duties.

Aerodrome Control Course :

This course is taught to the Aerodrome Assistants after they gain experience of about 6 to 7 years.

Duration	:	16 weeks (Previously 14 weeks)
Subjects Taught	:	Theoretical and Practical Training in Aerodrome Control, including in High Density Traffic situations, and Handling of all emergencies. The allied subjects are also a taught in a detailed manner.

On successful completion of this course, the official becomes eligible to be promoted as Assistant Aerodrome Officer, as per his/her seniority and as per the number of vacancies available. He will then undergo OJT and acquire Aerodrome Control rating.

Refresher and Approach Control Course : (Planned now)

After being promoted as Assistant Aerodrome Officer, the official is being sent to CATC, as per the seniority and the planning at the CATC, for the Approach control course.

Duration	:	10 weeks.
Subjects Taught	:	Mainly Approach Control (and Area Control) in Theory and Practice, including in High Density Traffic Situations and handling of all emergencies. A refresher and updation of the other allied courses will also be given during the course.

Re Training Courses for Aerodrome Officers :

The ab-initio Training for Aerodrome Officers recruited directly from the open market is for a duration of 12 months, divided into three modules.

I Module : (4 months) at CATC	Theoretical and Practical Training in Aerodrome Control, including in High Density Simulated Traffic Situations and Handling of emergencies. Other allied subjects such as Meteorology, AGA, Air Navigation, Communication Procedures, Navigational Aids, Fire fighting and Rescue Services, Morse Reception are also taught.
II Module : (4 months)	On the Job Training at one of the International Airports to the level of acquiring an Aerodrome Control Rating, and familiarisation with other ATC units such as Approach, Area, Radar.
III Modules : (4 months)	Theoretical and Practical Training in Approach Control, including in High Density Simulated Traffic Situations in all weather conditions, and Handiing of emergencies.

A continuation is made in the teaching of other allied subjects such as Meteorology, Air Navigation, and, also Air Law, Airframe and engines (Technical).

After Completing the CATC Course successfully, the Aerodrome Officers are posted to one of the International Airports, where they are given on the job training, leading to acquisition of the various ratings, as per the procedures enunciated in DARA Circular 2 of 1990. The period of on-the-job training depends on the rating being acquired, the station of posting.

Board for Examination:

The board of examination in Practicals in Aerodrome Control for the Aerodrome Officers consists of three members, one a Director from the International Airports, a Deputy Director from the international airports, and the Chief Instructor ATC, CATC.

The rating boards at the international stations for the various stations are as per those enunciated in the DARA Circular 2 of 1990.

Common Courses for those recruited initially as Aerodrome Assistants as also Aerodrome Officers :

The Assistant Aerodrome Officers, after nearly 7 to 8 years of service in this Cadre of AAOs, get promoted to the rank of Aerodrome Officer depending on the seniority and number of vacancies.

The Inter-se seniority between the direct recruit Aerodrome Officers and the Departmentally promoted ones, takes place at the level of Aerodrome Officers and their promotion avenues thereafter are follow a common route.

Specialised courses such as Search and Rescue Mission Coordinator and Assistant Mission Coordinators, Radar (Terminal and Area) and others are open for those of Aerodrome Officers rank and above.

The minimum qualification for the Radar Course is at least three years of service in ATC with one year's experience in Approach/Area Control after acquiring of these ratings.

Procedure for issue of ratings at small stations after the prescribed period of on-the-job training, is governed by DARA Circular 1 of 1992. With the implementation of this, the system of issue of ratings has been laid down for all the airports in India under the N.A.A.

It is noteworthy that a new computer-based state of art technology ATC Radar Simulator has already been commissioned and integrated into the training at the Civil Aviation Training College (CATC) at Allahabad. When I visited the CATC a few days back, the Radar Simulator equipment was shown to me which is, in fact, being used for imparting training to Air Traffic Controllers both for approach and area control in order to maintain safe and expeditious flow of traffic. I was told that training of Air Traffic controllers on live aircraft at the airports is so expensive that it cannot be afforded together with the other possible interference to the regular aircraft operations and it is for this reason that radar simulator has been introduced which simulates the exact conditions of flights of aircraft, radar equipment, radio communication channels, inter-unit ground coordination channels and thus providing realistic situation to the trainees. It is indeed a noteworthy project since a trainee can learn through mistakes which is not otherwise possible in actual field operations. I have been informed by AVM H.M. Shahul, Member Operations of the National Airports Authority that this project of CATC is under UNDP and is in progress to increase the capacity and capability of the training institute. Equipments worth US $ 1.455 million, have already

been added which includes major training aids like radar simulator, tower simulator, desk top publishing system, micro-wave training kits and personal computer system. As regards the objective of the project, it includes course standardisation : imparting instrumental techniques to the trainers : development of new courses such as Search & Rescue, Aeronautical Information System, Airport Management, Instructional Techniques etc. As a matter of fact, I was introduced to two American consultants who are now stationed at Allahabad to guide the CATC instructors to achieve the project objective. I was informed by the foreign consultants that the radar simulator which has been installed at CATC already is the best in the world and is comparable to any available at other training institutes in the world.

During my visit to Australia and Singapore, I discussed the subject of training of ATCOs with the Civil Aviation Authorities of these countries. It was noted that in Australia the Air Traffic Controllers undergo two years initial training consisting of theory, practical and simulator exercise. After this they have to pass written examination and undergo on-the-job training during which they handle air traffic under supervision of check ATCO. After they pass the checks, they get licence and rating in Tower, Approach, Area and Radar Control. If a trainee fails during initial stages of training, his training is discontinued. In order to monitor proficiency of the ATCOs, they undergo proficiency checks every six months. These checks are carried out even if the ATCOs continue to work in the same position. Every ATCO also undergoes medical examination once in two years if below 45 years of age and once every year if more than 45 years of age. Whenever an ATCO is transferred to a new station, he undergoes necessary training and checks relating to the procedures of the new station before he is allowed to work independently at that station. Every ATCO is given familiarisation flights approximately once a year. Qantas Airways gives six passages to the ATCOs to go and study the Air Traffic Control procedures of other countries. CAA even charters aircraft to give flight familiarisation to the ATCOs. The check

ATCOs are appointed on merit to fulfil the criteria laid down by CAA. The ATCOs during their initial training are also trained in meteorology and whenever required they give their own meteorological observations to flights.

While the Air Traffic Control in Australia is exercised by the Civil Aviation Authority, major airports are under the control of Federal Airports Corporation. The ATC and ground aids including safety services are provided by Civil Aviation Authority. Category-I ILS is provided at about six major airports and at other airports facilities like VOR, DME and NDB are provided. Only manual RVR is provided at present and RVR equipment is being installed at Sydney airport. At major airports, radar along with the transponder has been provided. All Control Towers at major airports are manned by only rated ATCOs. In addition to the ATCOs, there is always a supervisory controller who does not, in fact, handle the radio transmission, but takes a back seat to have an over-view of the entire situation though at times he himself transmits on radio transmission to assist the rated ATCO at the Control Tower. It is at this junction that I would like to point out that on a suggestion from the Court the National Airports Authority submitted that the presence of a supervisor at the Control Tower may dampen the activeness of the Controller. I do not, however, accept such a suggestion and record my observation to the effect that the presence of a Controller will not only improve the situation but will also enure to the benefit of the Controllers at the Control Tower for proper and effective management of the Air Traffic Control System.

The situation as above also prevails in Singapore. There are three Controllers and one Supervisory Controller at the Control Tower for effective management of the Air Traffic Control. The presence of the supervisor not only enures to the benefit as noted above, but during heavy traffic it is a positive help to the Air Traffic Controllers. It also avoids the fatigue of the Air Traffic Controller at the Control Tower.

In Australia all Air Traffic Controller are licenced by CAA. If an ATCO does not work in a unit for 14 days or more, he has to work under a Check ATCO for some time depending upon the period he has not worked in a unit.

Turning attention to our ATC system, it is placed on record that on the basis of available evidence on record and the literatures available in regard thereto, the procedure does not seem to be lacking in any way so far as the theoretical aspect of such a training is concerned. Practicability of the situation, however, is slightly different from its theoretical aspect and in that regard I wish to record certain observations of mine vis-a-vis the training procedure of the ATCOs and the ratings given to the ATCOs.

Admittedly Air Traffic Control in smaller airports are being effected by non-rated officers - a situation which is totally unwarranted. I remember having recommended while dealing with the Guwahati crash in regard to a Vayudoot aircraft that the National Airports Authority should ensure that only trained and rated Air Traffic Controllers should handle the traffic but that recommendation seems to be on paper only. As a matter of fact, however, I understand that the Government has thought it fit not to implement the same. I am at a loss to find such a state of affairs. For convenience sake, the Recommendation No.18 of the Report of the Vayudoot F-27 air crash at Guwahati and the Government's reaction thereto is noted hereinbelow :

Recommendation

"(xviii) National Airports Authority should clearly lay down the duties and responsibilities of the Aerodrome Assistants and Air Traffic Control Officers. It should be ensured that only trained and rated Air Traffic Controllers handle all traffic."

Government's Reaction :

"Recommendation No.18 : In recommendation No.18, National Airports Authority has been advised to lay down the duties and

responsibilities of the Aerodrome Assistants and Air Traffic Control Officers. The Court has recommended that it has to be ensured that only trained and rated Air Traffic Controllers handle all traffic. It is mentioned here that the Aerodrome Assistants are trained persons who are in the process of acquiring operational experience. It is to be ensured that the ATCO does not abdicate his responsibility and leave everything to the Aerodrome Assistant, who although trained, is not competent to handle air traffic control independently in all types of weather and approach conditions."

It seems that the Government has taken note of the conduct of the ATCO and his training but has not dealt with the rating of the ATCOs at all. In the normal course of events, however, it is deemed that the Government has applied its mind and deliberately left it out, but considering the seriousness of the matter, I should have thought that the Government should give some reason as to the non-acceptance of this recommendation in regard to the ratings of the ATCOs. While it is true that once the Government has not accepted a recommendation specifically, a High Court Judge holding an air crash inquiry ought not to recommend it for the second time, but considering the safety aspect I cannot but to note here my anxiety in regard to the ratings of the ATCOs manning independently the radio transmission at any airport. It is a safety requirement and as such Government should reconsider its decision in regard thereto. There should not be any compromise with safety standard - as noted above. Human lives are precious and there should not be any laxity or sense of complacency in so far as the safety sphere is concerned.

It is not out of place to mention that in my earlier report of the F-27 air crash submitted in March, 1989, I have also recommended the licensing of the ATCOs : this particular recommendation, even though has been accepted by the Government, but no step whatsoever has yet been taken in regard thereto. Recommendations are made by the Courts of Inquiry upon proper deliberations and on appraisal of the entire situation and once the Gov-

ernment accepts such a recommendation, there should not be any time gap for its implementation.

Coming back to the factual aspect of the matter in regard to the Air Traffic Control at Imphal Airport, it is seen that the traffic was handled by one Mr. P. Sengupta, an Air Traffic Control Officer, independently without being banked by any rated officer by the Board of the National Airports Authority. The evidence of Mr. Rastogi being the Senior Aerodrome Officer is a revelation to this Court. Mr. Rastogi stated that Mr. Sengupta is the only fully qualified ATC Officer for Imphal and to a pointed question as to whether Sengupta was a rated officer, there was a definite answer to the affirmative. On being further asked as to who has rated Mr. Sengupta, the answer of Mr. Rastogi was - "by my predecessor". I am at a loss to find that how a single individual can rate an officer giving independent charge of Air Traffic Control at an airport. Mr. Rastogi explains, however, that at the smaller airport no elaborate procedure is followed and it is the senior officer who is competent to judge whether the junior officer has familiarised himself with the local procedure, local condition, local traffic pattern, local environment and the local topography and after observing that the junior officer is working well and that he is able to handle the Radio Transmission well then he is allowed to handle the R/T independently after giving him the rating. No documentary evidence, however, was produced before this Court as to the certification by the senior officer. Mr. Rastogi further elaborated the policy of the National Airports Authority to the effect that density of flight is the only criteria in the matter of adaptation of the rating procedure at the Control Tower. Mr. Rastogi went on to say that National Airports Authority can afford to do away with the rigours in regard to the independent handling of R/T by the rated officers in low density flight operational airports. It is the definite evidence of Mr. Rastogi that "it is only the number of operations, the number of aircraft operating at any airport which is important to decide whether he is to be given more elaborate training before handing over charge independently at an international airport or he can be

handed over charge of a smaller airport after the senior officer who is present certifies that he is competent to take over the works at the airport. In this context, Question No.72 and its answer ought to be noted and which is reproduced hereinbelow :-

> "Q.72 : That is why I am asking you that the level of flight only would be considered by National Airports Authority as to what sort of training would be given to the ATCOs. If there are more traffic, more rigorous is the training. If there are less traffic, less rigorous is the training - is that so ?/ That is correct."

On the basis of aforesaid, therefore, it appears that the National Airports Authority maintains dual standards, one for higher flight density airports and the other for lower flight density airports. In my considered view, maintenance of dual standard ought not to be resorted to and all ATCOs should be rated before allowing them to handle R/T independently irrespective of flight density. Rating cannot be effected only for the purpose of handling more aircraft as it has an inbuilt safety device which is also otherwise required for low flight density airports. There cannot be any compromise with safety and this policy of the National Airports Authority thus in my view ought to be dispensed with and same standard be made applicable to all airports irrespective of the traffic position in regard to the ratings of the ATCO. In the event of transfer of the ATCO to a bigger airport further training may be imparted to the ATCO but that does not mean that the required training need not be given to an ATCO by way of a rating in smaller airports.

I would not like to be misunderstood about the capability of Mr. Sengupta as an Air Traffic Controller, but the observations as above only pertain to the policy of the National Airports Authority. The call-outs given by Mr. Sengupta to the aircraft cannot be termed to be wrong as such though slightly better phraseology could have been used, particularly in regard to the clearance for direct outbound. No strict exception however, can be taken to

such a clearance as above by reason of subsequent call outs by ATCO being in order.

The other aspect of this issue ought also to be noted at this juncture. No refresher courses are arranged for the ATCOs. The National Airports Authority obviously thinks it fit enough not to provide any refresher course for the ATCO, but in my view, the ATCO has an equal if not more important role to play in the matter of air safety vis-a-vis the pilots on board the aircraft. The licensing of ATCOs would definitely bring in a much more healthier and safer situation since in that event the DGCA being the regulatory authority would be able to formulate and provide adequate safety regulation in regard thereto. Incidentally it is to be noted that in my earlier report in regard to the Vayudoot air crash at Guwahati, I specifically recommended that the refresher courses should be arranged for ATCOs at least once a year. Even though that recommendation has been accepted by the Government, but no step whatsoever has been taken by the National Airports Authority to implement the same. I understand that the reminders from the Director General of Civil Aviation's Office has yielded no result whatsoever.

The availability of ATC tape is also of very great importance for the purpose of monitoring the proficiency of the ATCOs. The National Airports Authority would be well advised to have random checks of the ATC tape so as to ascertain the proficiency of the ATCOs.

It is not, however, out of context to note the third aspect of this issue viz. the familiarisation flights for the ATCOs. The Air Traffic controllers are the persons who guide the aircraft in all eventualities and they therefore, should have proper appreciation of the cockpit instruments as otherwise there is likelihood of a communication gap between the pilot and the ground control. This possibility would not, however, be there in the event of proper knowledge about the cockpit panel instruments. In the premises

familiarisation with the equipments so far as the ATCOs are concerned, in my view, is a question of primary requirement. The National Airports Authority would be well advised to modulate the necessary details with least possible delay. This observation of mine is based upon the fact that the days of Dakotas are over and we are in a modern jet age with very high speed fly-by-wire aircraft.

14.1 (c) **Electronic/Technical Officers** :

The personnel of Technical discipline of NAA currently are being recruited from the colleges at two levels namely Electronic Assistants and Electronic Officers. The entry qualifications of EA is Diploma in Electrical/Electronic stream or B.Sc (Physics Main). for Electronic Offficers a degree in Engineering (Electronics) or its equivalent is mandatory.

Training Courses - Basic

The basic training of Electronic/Technical Officers is for 22 weeks. They are trained on basics of VOR, DME, ILS and other communication equipments. On successful completion of training, they are sent to field stations to work under experienced officers only on general equipments like HF transmitter receiver, VHF equipment and terminal building equipments like tape recorder etc. After gaining proficiency on these equipments and experience of 6 months in the field a EO/TO is proficient to carry out independently the requisite maintenance and repair on the above equipments. At this stage they do not handle specialised nature of tasks like ILS, DME, VOR, RADAR etc.

Specialised Training

After gaining experience not less than 2 years EO/TOs are sent for specialised training on RADAR, ILS, VOR, DME, flight calibration equipment, AMSS, computer applications, Aeronautical Mobile services on HF RT. Duration of this training is 6 weeks.

Proficiency Assessment

The board comprising of Director from Hqrs. + Chief Instructor Communication from CATC and one more Instructor from CATC test the Officers on completion of 22 weeks as well as 6 weeks courses to assess their proficiency and declare them competent. A certificate is being issued presently by Principal, CATC both qualifying them initially and also on specialised equipments.

Proficiency on the ground

a) After basic course of 22 weeks and gaining the experience for 6 months the EO/TOs are competent to undertake the tasks of maintenance of general equipments like HF RT, VHF equipments and tape recorders.

b) On completion of specialised course of 6 weeks these officers work under experienced and qualified officers on equipments like Radar, ILS, VOR and DME for 8-12 weeks to gain proficiency and declare independent to handle the equipments. In fact, independent posts as EO/TOs to take the charge of stations are mostly those officers who are experienced and proficient to handle such equipments where they are posted.

Electronic/Technical Assistants

EA/TA are given 22 weeks initial course basically to work under the supervision of qualified EO/TOs. EA at no stage hold independent charge at any field or station. Their basic training includes imparting training of Transmitters, receivers, test equipments and jobs like soldering etc. The TA course is designed to appreciate the problems involved in the maintenance of both preventive as well as general maintenance and lend services to the qualified EO/TOs in their conduct of trouble-shooting and maintenance of the equipments.

Proficiency Assessment

Like in the case of EO/TOs their proficiency assessment is done by three members comprising of local board from within CATC and assess accordingly.

Assistant Technical Officers

ATO is not direct recruitment but a promotee from EA/TA. An EA/TA after completing at least 5 years becomes eligible for promotion to ATO depending upon the efficiency and in their own turn. For this purpose they are sent to CATC for qualifying course which is of the duration of 12 weeks. Like in the case of Aerodrome discipline, those officers who do not make the grade are sent back and here also these are given 3 chances to make the grade. On gaining requisite proficiency an ATO is allowed to work on equipments like tape recorders, VHF/HF, NDB, X-Ray baggage and some specialised equipments. In small stations where there is only NDB or X-Ray Baggage, an ATO also posted as independent charge of the station.

Updatement

The courses, like in the case of Aerodrome discipline, are updated periodically by the CATC after getting requisite approval from the Hqrs. The UNDP project association with CATC aims for enhancing the capability of Technical discipline in the NAA.

General

I understand that in the past, there were two streams in the Technical stream at the time of entry namely Technical Assistants and Communication Assistants and secondly Technical Officer/ Communication Officer. Technical Officers used to deal with technical disciplines like maintenance etc. whereas communication

officers dealt with basically communication aspects of the operations. This was the age old pattern followed by the DGCA. After the formation of the National Airports Authority, it was felt as I have been informed that some highly and well-qualified technical officers were being lost in general stream of Communication discipline and hence the new concept known as Electronic Assistants and Electronic Officers was introduced for better utilisation of human resources. This changed system as appears, had started about two years back and five batches of students of Electronic Assistants as well as Electronic Officers have passed out from CATC so far. The 6th one is undergoing training currently.

It is to be made clear, however, that maintenance of these highly sophisticated ground equipments being the navigational and landing aids for the aircraft, should be effected in a highly professional manner and only competent and efficient people ought to be engaged therefor. The system maintained by the Engineering Department of Indian Airlines by way of written schedule checks, I feel, ought to be introduced in the matter of regular maintenance of these equipments. The same would not only enure to the proper maintenance of the equipment but also obliterate the possibility of human errors in the matter of maintenance of these sophisticated equipments.

14.1 (d) **Cabin Crew Training** :

During the entire course of hearing, both at Calcutta and at Imphal no submissions have been made on behalf of the cabin crew in spite of notices being served on to the union of the cabin crew of Indian Airlines. It is only in the morning of 27th April that my Secretary has made over the original of the affidavit filed by the cabin crew union. Scathing remarks have been made in the affidavit as regards the training procedure of the crew members of Indian Airlines by reason wherefor I had no other option but to send a questionaire to the Director of Operations through Capt. P.M. Jog and I also received the reply thereto on the same day.

It has been stated in the affidavit that :

i) There is no standardised training in Indian Airlines.

ii) The duration of each course of training programme varies as per the whims and fancies of the management of Indian Airlines since there is no adherence to the definite time and lecture hour for different subjects of training.

iii) There is no control whatsoever on the part of DGCA in respect of the training of the cabin crew.

iv) No fire drill training is provided to the cabin crew by reason of non-availability of a 'Mock Aircraft'.

v) The management of the Indian Airlines does not also deem it fit to take the assistance of Air India for training of their cabin crew members.

The Indian Airlines, however, in their reply categorically disputed the above noted submissions of the union and stated that there are prescribed syllabus for cabin crew and the Indian Airlines have abinitio training course which is the basic training course given after the cabin crew are recruited and before they are sent on flight. The duration of this course is 8 weeks on ground training for a batch of 25 trainees. Four flights on each type of aircraft are given as on-the-job training. Apart therefrom the Indian Airlines stated that yearly refresher courses are conducted for all cabin crew at the regions and there is a prescribed syllabus for such a refresher course. The duration of the refresher course is three days for a batch of 10 to 12 cabin crew. The Indian Airlines stated that in addition to these courses, the airlines has conversation courses for the new aircraft as and when required and the duration of these courses depend on the quantum of information to be imparted to the trainees. As regards the fire drills, the answer was

in the affirmative and so is in regard to ditching drill and evacuation training to the cabin crew. The syllabus for cabin crew training was also sent along with the reply of the Indian Airlines which provide a 60 hours course and cannot but be termed to be satisfactory in nature. On the score of training of pilots and ATCOs and other technical officers, I have recorded my observations that there is some amount of difference between theoretical scope of training and actual imparting of such a training to the trainees. The cabin crew themselves feel it that the training imparted is not sufficient, the management should, therefore, see to it that the training to be imparted on to the cabin crew ought to be standardised and there ought not to be any departure from the training standard as prescribed.

While dealing with the matter two other issues which have been raised by the Union ought to be noted, namely, the FDTL and the fatigue of the cabin crew. As regards FDTL, the affidavit pointedly records that the cabin crew members ought to work at a stretch for 11 hours in a calendar day. The affidavit goes on to record, however, that this 11 hours a day duty time was arrived at though bilaterally in the agreement with the operator and the union but in fact it becomes too much of a burden for the cabin crew to work for 11 hours a day and the same might, therefore, endanger the flight safety. There cannot be any manner of doubt that 11 hours a day duty for a cabin crew may turn out to be very stranuous but the operator has stated that normally they are rostered in such a way that the duty time does not exceed 5 to 6 hours a day and it is only when the standby cabin crew are pulled out due to exigencies they may be required to work upto a maximum off 11 hours a day as per the agreed FDTL. It, therefore, appears that under the normal circumstances the duty hour being not more than 5 to 6 hours, no exception can be taken and it is only in emergency situation that this FDTL is taken recourse to by the operator, but these are exceptions and exceptions cannot termed to be the rules as such I do not find any serious objection in regard thereto at least till such time a new agreement is arrived

at by and between the union and the management of the Indian Airlines. The agreement has a binding force and it is not for this Court to comment thereon rather for the parties to the agreement to change the terms.

The issue as regards the fatigue is also co-related with the FDTL and by reason of my obseervation in regard to FDTL I do not wish to record any finding in regard to the issue of fatigue as well excepting, however, stating herein that the operator should look into the issue without much loss of time.

14.2 **Frequent Flying on one route by the pilot** :

While it is true that familarisation with a particular terrain is required for a safe flight, but frequent flying in one route is likely to give a bit of a over-confidence to the pilot, though however, Capt. Mehta while deposing before the Court stated that question of being over-confident does not and cannot arise so far as flying is concerned. Considering, however, the human mind and the psychology, I am not in a position to concur with the statement of Capt. Mehta. It came on record that Capt. Halder had operated 36 flights from Calcutta to Imphal within a period of preceding six months. A question had arisen as to why he was operating so frequently on this route. Capt. Mehta in this regard stated that if a commander wants to fly on the same route, there is no bar in the Indian Airlines regulations. He also clarified that in case of Boeing 737 aircraft they have only two or three commanders at the Calcutta base and other Boeing 737 pilots come from Delhi and Bombay for operating flights in Calcutta region. If these commanders do not turn up then the pilots based at Calcutta may be sent on one particular route and one sector only. When he was asked that if a pilot wants a particular route, do they give that particular route whenever he wanted; Capt. Mehta replied that if the commander requests it can be accepted. He also clarified that any change in the roster duties cannot be done by the pilot himself without the permission of the roster-incharge.

Shri S.K. Srivastava, Deputy Manager Flight Operations, who was incharge in the roster Section of Boeing pilots at Calcutta at the relevant period and who was rosting Boeing pilots was asked how Capt. Halder had flown so many flights to Imphal, it was stated that some flights were given to Capt. halder on his request and some were given by them depending on the prevailing situation. Shri Srivastava informed that Capt. halder sometimes used to request for flights to Imphal. He, however, never asked why Capt. Halder was asking for flights to Imphal.

Considering the above, in my view, Capt. Halder had a bit too much of familiarity with the terrain which may have brought about a feeling of over-confidence in him which by all standards ought to be done away with and the operator would be well advised to give due consideration to this aspect.

The observations as above also find support from the intra-cockpit conversation at 07:08:44 UTC to the effect "You are exactly - - This is 25 miles Roger Aye Ekta Hill Range, Oye Ekta Hill Range - Do Tor Majh Khanne" (This is one hill, that is another hill and in between the two), which goes to show how familiar the pilot was with the terrain and the pilot knew exactly what he was doing. This indicates that he was giving distance call-outs and positioning himself not on the basis of any instrument reading or estimate calculations but on some ground features with which he was very familiar.

14.3 **Pre-flight Medical Checks of Crew**:

Though I have already dealt with this aspect of the matter in regard to the pre-flight medical check up, but I wish to made certain general observations in regard thereto and hence a special mention is being made.

As noted above human lives are precious and it is on one

particular person that these lives are dependent on board the aircraft as such this particular person being the Pilot-in-Command of the aircraft should be under no inconvenience of whatsoever nature. Proper mental equilibrium ought to be maintained and for this purpose this pre-flight medical check has been envisaged by the Director General of Civil Aviation and the operator has been asked to assure such a state so far as the pilot is concerned. It is now on record that the Indian Airlines has the system of pre-flight medical checks by doctors in the roll of Indian Airlines. The certificates produced before the Court in regard to the two pilots of the ill-fated flight (IC-257), however, leave much to be desired in the matter of pre-flight medical check-ups. The proforma has been made out on which the doctor is to give a certificate, but apparently the doctor does not have the time to write even at the columns specified for alcohol checks. A plain look at the certificate show that the certification is to the detection of abnormality in the pilot only, since it records "NAD" (No Abnormality Detected) - what did the doctor mean by that - did he expect that the pilot would behave abnormally in the morning when he has come to operate a flight - did he expect that the pilot would be so drunk that he will not be able to walk properly - did he expect that the pilot would be using languages which cannot and does not befit a gentleman : it never occurred to the operator that this cannot be a proper certification for a proper medical check up. The administration of the operator ought to rise up to the occasion to see that the proforma envisaged for medical check-ups is being dealt with by their medical officers in the proper spirit for which it has been so devised. It is not out of context to note that some days back a newspaper report appeared recording therein the protests of the pilot in the matter of monitoring the alcohol checks by DGCA officials. I should have thought that the pilots themselves would volunteer for such a check as otherwise the entire ethics of flying would be in jeopardy. In any event, I do not see any justification of such criticism or protest since it is only for public safety that these checks are monitored. Be that as it may, the operator would be well advised to look into this aspect of the matter also and see that this medical

check up is effected in a manner as is conducive to safe flying rather than in a slip-shod fashion as is evident from the pre-flight medical check reports of Capt. Shekhar Halder and Capt. D.B. Roy Chaudhary.

It will, however, be worthwhile to record that in Australia there is no pre-flight medical check-up. On being asked about the danger of not having a morning pre-flight medical check-up, prompt came the reply from the Qantas that the pilots of the Qantas Airways are so self-disciplined that such a check is not required. The Airways has framed a regulation that no pilot should have a drink after 8 O'clock in the evening if they are operating any flight next day morning till noon time and the pilots themselves stop drinking as a matter of fact before that time and under no circumstances shall continue with the drink after 8 p.m.

If the operator can introduce such a culture in its system, I am also inclined to believe that no pre-flight medical check-up would be needed since trust and confidence on to the pilots can bring home itself the strictest of regulatory methods.

14.4**Search & Rescue**

Search and Rescue are the two most important aspects in the civil aviation industry in the country. I am constrained to say that the National Airports Authority has had no training programme in regard thereto until very recently. Now, of course, a training programme with a search and rescue course objective has been framed and the course duration being - four weeks and entry level is only from experienced Aerodrome Officers and Senior Aerodrome Officers - a welcome course undoubtedly, since human lives may be lost by reason of delayed search and rescue. Time has now come up for consideration of all the agencies involved in the Civil Aviation industry to sit down and evaluate some procedure so that this particular issue of search and rescue is given its

due importance. Though the para-military forces and the local police administration may be approached for necessary assistance, but that does not mean and imply that the agencies involved with the Civil Aviation of the country will be a mere passive spectator whilst others cracking their head to effect the search and rescue of the victims of an air crash.

Mr. Rastogi in course of his evidence, in no uncertain terms stated that it was no part of his duty to take steps in the matter of search and rescue in the event the aircraft accident takes place beyond the airport vicinity. This attitude of the Senior Aerodrome Officer, I am sorry to note, cannot be appreciated. This shows that the Senior Aerodrome Officer lacks a sense of responsibility to the safety of the passengers. I understand that as early as 1976-77 the Civil Aviation Directorate, Government of India has published a booklet entitled 'Organisation and Procedure for Search and Rescue of aircraft in distress' containing the detailed procedure including a chapter on the definitions of the expressions used therein. The appendix I to the booklet itself provides the names of the officers who should be responsible for the search and rescue operation in the event of there being any unfortunate incident and invariably it is the Regional Director of the Region who have been stated to head the search and rescue service. The National Airports Authority being a successor of the then DGCA excluding the regulatory functions ought therefore be made responsible for such a rescue operation and I fail to appreciate the evidence of Mr. Rastogi being the Senior Aerodrome Officer to the effect as noted above viz. he has no responsibility for search and rescue in the event the rescue operation is outside the airport area since it will then be the duty of the State authority to organise the search and rescue. I record my utter dissatisfaction to this particular piece of evidence of Mr. Rastogi.

Incidentally it is to be noted that it took quite some time to locate the wreckage and had there been a Emergency Locator Transmitter (ELT), this delay in locating the wreckage could have

been avoided. Though it is true, however, that there were no survivors and the deaths were instantaneous, but it is always advisable and better for all concerned to locate the wreckage at the earliest possible opportunity and as such installation of an ELT is of primary importance. I understand that the Director General of Civil Aviation has already issued a directive about the installation of the ELTs in all aircrafts and for passenger aircrafts the time limit given by the Director General is upto 30th April, 1992. I hereby record my appreciation for the steps taken by the Director General in that direction. I have, however, been informed that though the operator (Indian Airlines) has installed an ELT instrument in their aircraft, but the same is water activated type only and not impact activated. The Director General, however, should make it a point to see that, in fact, the impact as also the water activated system are introduced in all passenger aircraft as early as possible and in default of such a step by the operator, necessary regulatory steps be taken without any compromise whatsoever since it is an essential requirement for search and rescue.

14.5 **Accident Prevention Cell**

In the introduction chapter of this report, I have stated that monetary compensation or a word of sympathy will not do - we will have to rise up to the occasion to stop the recurrence of these accidents which is otherwise avoidable in nature. I also recorded that the time and hour has come for us to do our utmost to save such fatalities - this observation of mine is not out of context at all since it is always better to take a preventive action rather than to do a post mortem action. Our endeavour should be directed to avoid such accidents and with that perspective in the earlier report I recommended that there should be a new dedicated cell for accident prevention work. I understand that the cell has been created by the DGCA and has been duly approved by the Ministry, but what surprised me most, is the personnel of the cell - there is only one post of an officer sanctioned by the Government for the cell. I do not understand as to how sanction to one post could be made

in a cell which is supposed to be working for prevention of accidents. It has come in evidence that even the airports have not been inspected for years together, far apart of having a total supervisory capability of the cell for prevention work. Implementation of the recommendations of the earlier Courts of Inquiries is also a part of the duty of the special cell and by reason of the non-availability of the personnel, the status in regard thereto is also far from satisfactory. The other function which the special cell ought to discharge is the monitoring of the FDRs, DFDRs and CVRs - is that humanly possible for one person to do for the prevention of accidents - the answer cannot but be in the negative. It seems that the Government has not appreciated the proper spirit with which this particular recommendation was made as otherwise the action of the Government in implementation thereof would not have been in the same fashion as it has, in fact, been effected. I hereby emphasise again that there should be a proper and adequately staffed special cell under DGCA for the prevention of accidents and the Government should rise upto the occasion and to take effective steps for such prevention of accidents.

14.6 **Control Tower Equipments**

a) ATC Tapes

ATC tape is one of the primary instruments located at the Control tower, it has to discharge definite functions and an effective method to cross-check the transmissions from both the aircraft as also from the ground. This also serves the vital need of monitoring the actions of both the pilots and the ATCOs.

Unfortunately, however, the evidence disclosed before the Court that the ATC tape at Imphal Airport has not been commissioned for the last about eight years. It is indeed a sorry state of affairs - can we in this country afford to keep an expensive equipment in unserviceable condition for a period of eight years when there is so much of economic constraints in the national financial

position - this is apart from the safety aspect and its utility as a Control Tower equipment - in my view, the answer cannot but be in the negative. Nobody seems to be bothered about the equipment lying at Imphal Airport for such a long period of time. Mr. Rastogi has stated that it required some spares. The Senior Aerodrome Officer ought to be slightly more careful and particular in regard to the equipments at the Control Tower. The matter, however, needs further investigation by the National Airports Authority and appropriate steps be taken against the delinquent officer or officers.

b) Status Indicator Lights

It seems to be a perpetual problem in the North-Eastern region of the country. While I was investigating the Guwahati air crash, the same state of affairs as regards the status indicator lights existed - if the National Airports Authority thinks it fit enough not to maintain the status indicator lights at the Control Tower then why have an indicator light - obviously the NAA has the impression that unserviceability of the status indicator lights does not really matter. I, however, have a different opinion in the matter and in my view, maintenance of the status indicator lights at the Control Tower is imperative as that would provide an immediate indication as to the serviceability of the landing and navigational aids at the airport. It helps the ATCO to communicate the status to the pilot and as such is a safety requirement and the National Airports Authority would be well advised to see the serviceability of the status indicator lights at the Control Tower.

c) RVR Indications

Runway Visual Range (RVR) equipment is a definite assistance in the matter of assessment of the visibility in the runway direction of the airport area. In the absence of RVR equipment, the ATCO shall have to depend on the subjective assessment of the visibility of the Meteorologist of the airport, but with a RVR equip-

ment the indications at the Tower would appear and as such more or less correct visibility prevailing at that point of time would be transmitted to the pilot of the aircraft. This undoubtedly would be a very great assistance to the pilots as also to the ATCO at the time of instrument approach and landing during unfavourable weather conditions.

14.7 Implementation of earlier Recommendations

During the course of hearing, Capt. Bagchi appearing for the Air Passengers Association laid special emphasis in regard to the implementation of the earlier recommendations. I record my concurrence with the submission of Capt. Bagchi. Even at the cost of repetition, it is to be emphasised that Courts of Inquiry deal with the matter in very great detail upon evidence and on perusal of necessary documents - it applies its mind and considering the requirement of the situation - the recommendations are made. It is, therefore, a prime requirement that the recommendations so accepted by the government ought to be implemented without any time lag and with utmost expedition with all sincerity and in the spirit in which it has been recommended. The implementation of the recommendations ought to be effected though by the Government, but the Director General of Civil Aviation has a definite role to play in the matter of bringing home the acceptance of the recommendations by the Government. The Secretary in the Ministry of Civil Aviation should have periodic review as regards the implementation of such recommendations. It ought to be a joint and concerted effort of all concerned in the Civil Aviation industry of the country for safe flying of the passengers.

14.8 Operator's Flight Safety Directorate

In accordance with the normal practice of an Airline operator, the Indian Airlines is also on record has a Flight Safety Directorate. I emphasise the word "On record". This emphasis is by reason of the fact that it existed only on record and not on actuality of the situation. No evidence has been tendered before this

Court of Inquiry as to the functioning of the Flight Safety Directorate excepting for the last few months. As a matter of fact, the documentary evidence disclosed that prior to September, 1991, no meeting of the Flight Safety Committee in the Directorate of Flight Safety of the operator did take place - is it a conceivable situation that an organisation like Indian Airlines will not have any meeting of the Flight Safety Committee for a period of three years - the answer obviously would be in the negative.

I must, however, appreciate the gesture and sense of duty of the present Director of Flight Safety in the matter of production of this piece of evidence before the Court. It is for the first time in three years that the present Director Capt. P.M. Jog has brought about a meeting of the Committee in his Directorate so as to bring a healthy situation in flight safety in the country so far as domestic operations are concerned. For convenience sake the documentary evidence made available to this Court is reproduced hereinbelow:

INDIAN AIRLINES HQRS.
(Directorate of Flight Safety)

26th Sept. 1991

Sub: Flight Safety Committee Meeting held on 12th Sept., 1991.

This Flight Safety Committee Meeting was held after a period of 3 years. All the invitees excepting O.M., Madras, were present. After conducting the meeting for regular Agenda points, all the OMs along with Director of Training, Director of Operations and Director flight Safety continued meeting after the lunch time. During this meeting Director flight Safety pointed out that the number of accidents/incidents that are taking place is alarming and asked the invitees to discuss on the subject.

Most of the members agreed that in order to improve the safety records of the Corporation, it is a must, that the flights are monitored for standard operating procedures.

For this Directorate to monitor any deviation from the standard operating procedure it is a must, that we should get the flight Recorders (CVR/FDRS) in time and also the readings of such Flight Recorders must be reliable. However, it is to our utmost dismay, that we find such required Flight Recorders are either not made available in time or data is not reliable. We have time and again raised memos and letters to the engineering Directorate, with copies to you regarding non-availability of Flight Recorders and its

reliability. However, we do not find any improvement. Under the circumstances it is rather difficult for this Directorate to maintain the required vigil.

It was also agreed in the meeting that OM's and Dy. OM's will conduct series of observation flights. Such checks will not be less than 10 per month.

The undersigned also suggested that in order to develop personal relationship between senior Commanders and line Pilots, small batches of pilots for each Dy. OM may be formed and such batches must meet at least once in 10 days. Such meetings will not only develop personal relationship between the junior and the senior pilots but also will help in getting the feedback of any short comings which may be existing. This also will develop OM's agreed that this sort of teams will be formulated from the month of October and will start functioning.

This is for your information and suggestion, if any.

Sd/-
(Capt. P.M. Jog)
Director Flight Safety

Flight Safety Directorate of an Airline operator is a necessary requirement for internal monitoring of their own performance vis-a-vis the passengers safety. The operator depending upon his experience evolves the safety method in regard to the compliance of the safety regulations as enunciated by the Directorate under the Director General of Civil Aviation. There shall have to be an introspection and the operator should realise the various safety aspects in passenger flying - can it be said that the operator has been doing things in accordance with the expected standard of flight safety - on the basis of the documentary evidence disclosed before this Court, I am afraid the answer cannot but be a positive 'No'. The entire Directorate if I may record should be revamped and restructured since a feeling of insecurity is gradually gaining ground in the minds of the air passengers in the country.

I cannot help but record my observations that the Flight Safety Directorate though needs to be headed by a very experienced pilot but after taking over charge his flying similar to that of a line pilot should not be permitted but he should be allowed to obtain compensatory allowances as if he was, in fact, flying. As a

matter of fact, the executives of the operator ought not to be asked to fly as they are now flying. While it is true that Capt. Mehta being the former Operations Manager, Calcutta Region, in no uncertain terms stated that the executives though flying have enough time even otherwise to look after the institution as a whole and to frame the policies of the operator for safe flying of air passengers. I however cannot concur with the evidence of Capt. Mehta. The company has formulated a policy of 65 flying hours in a month for the line pilots as against the maximum of 125 hours as appears from the Aircraft Rules. The executive pilots, it is in evidence do invariably fly more than 65 hours as they do not have the FDTL for 65 hours, though however it shall have to be within the prescribed limit of 125 hours as noted above. Can an executive pilot after say flying nearly about 70 to 80 hours a month devote much time and energy for the purposes of administrative works - I have my definite reservations about the same. Considering the process of thinking and the time required for uplifting the standard of flying if the concerned executive is busy in flying only". Somebody should be made available to devote some time and energy for the betterment of the organisation in all its spheres, be it operational, engineering, commercial or safety. The system prevalent, however, does not have such an opportunity. The executives obviously would be flying to stations which provide for a night halt and if two such flights are taken in a week that would mean an imply that the concerned executive is not available at the station for a period of four days in a week - can an organisational set up be improved in the event of a departmental head being away from the station for a period of four days - I am afraid even to a common man the answer would be in the negative. The procedure prevalent in Australia as noted earlier in this report ought to be considered at this juncture.

Time has now thus come for appraisal of the whole situation so that flight safety in any way be not in jeopardy. Incidentally it is to be noted that Aircraft Manual as published by Government of India though elborate in nature but does not, however, contain any

note or regulation as regards the air safety and considering the situations prevailing in the civil aviation industry in the country, in my view, it is high time that the legislature may ponder over it afresh to incorporate some rules relating to air safety in the Aircraft Rules itself.

14.9 **Present System of Accident Investigation**

During the course of hearing, a doubt has been expressed as regards the method of investigation of accidents including the appointment of Inspector of Accidents. In terms of Rule 71 of the Aircraft Rules framed under the Aircraft Act 1934, the Director General may order an investigation of any accident involving an aircraft and the Rule prescribes the method and mode of investigation, the powers of the Inspector of Accidents have been laid down under Rule 72. This appointment of Inspector of Accidents pertain to any reportable accident and Rule 75 authorises the Central Government to have a formal investigation if it is found to be so expedient. The language of Rule 75 is clear and unambiguous. Rule 75 provides that where it appears to the Central Government that it is expedient to hold a formal investigation of an accident, it may whether or not an investigation or an inquiry has been made under Rule 71 or Rule 74 by order direct a formal investigation to be held - it therefore appears that the legislature has conferred power on to the Central Government irrespective of an earlier investigation by the Inspector of Accidents to hold a formal investigation. There is no conflict neither there is any difficulty in the matter of constituting a Court of Inquiry for the accident, since not all accidents are being investigated by constitution of a Court of Inquiry by the Central Government. The expressions "whether or not an investigation or an inquiry has been made under Rule 71 or 74", makes the position amply clear.

The legislative intent is clear enough in Rule 75. In my view, considering the immediate need for maintenance and preservations of materials, appointment of an inspector is of utmost importance.

Immediately after the accident if the materials are not collected, there is every likelihood of the evidence being lost since some amount of delay in the matter of formation of the Court cannot be avoided. The notification shall have to be published upon consideration of certain details which cannot be done immediately on the happening of the accident. Considering the above, the legislature also has left it to the discretion of the Director General of Civil Aviation in regard to the appointment of an Inspector of Accidents. In my view, no exception can be taken to the present system of accident investigation rather I would like to put on record that without the appointment of an Inspector of Accident, it would be a near impossibility to come to a definite finding by reason of the unavoidable time lag. It is to be noted, however, that there is not even a remote possibility of any conflict between the report of the Inspector of Accident and that of the Court since immediately on formation of the Court of Inquiry the Inspector of Accident acts in terms of the direction of the Court and not independently on its own.

14.10 **Regulatory Functions of D.G.C.A.**:

Prior to the formation of the National Airports Authority, the entire Civil Aviation chapter was being monitored by the Directorate under the Director General of Civil Aviation, but after the formation of the Authority as above, there is bifurcation of the powers of the Directorate including some of the regulatory functions as well, though however, the Directorate under the Director General of Civil Aviation continue to remain the regulatory authority of the Civil Aviation of this country. In my view, however, though National Airports Authority may continue to discharge its functions as has been laid down in the statute constituting the National Airports Authority, but there should be in addition to the authority a regulatory authority so that the entire civil aviation industry can be brought under the vigilent supervision of the regulatory authority. During the course of hearing, it has come to light that airport minima is one such sphere wherein the DGCA

has no role to play in fixation of the same. The Directorate of the Director General of Civil exists for safe flying in and around and over the country. Airport minima is a safety measure which should also come within the powers of the regulatory authority. Preparation of ILS chart is another sphere wherein the intervention of the Directorate under DGCA cannot be undermined. These are all safety measures and there ought to be some such supervision by the regulatory authority as otherwise in the event of an unfortunate eventualities there would be an attempt to shift the responsibility from one to the other. Needless to say and as I understand that it is neither feasible nor practicable for even the Directorate to function with its depleted staff pattern - aerodromes admittedly are not being inspected for operational standards for years together. Regular monitoring of FDRs; DFDRs; CVRs and ATC tapes cannot be effected in the manner as is expected. The entire organisation, therefore, needs restructuring and revamping to facilitate the Directorate to discharge its regulatory functions. Incidentally it is not out of context to note that various other Courts of Inquiries including my earlier report highlighted this aspect of the matter, but unfortunately, however, no step as yet has been taken by the Government in that direction despite acceptance of the recommendations by the Government. I wish to put on record that this aspect of the matter ought to be looked into and be dealt with utmost promptitude so far as the Government is concerned, as there cannot possibly be any compromise with the safety of the public at large. It is further to be noted that with the increasing air transport activity including coming into existence of the Air Taxi operations, the role of DGCA cannot in any way be undermined and the Government would be well advised to rise up to the occasion so that the Directorate functions effectively and in the true spirit in which it was formed as early as 1927.

14.11 **Formation of an Independent Air Safety Board** :

After a series of fatal accidents in the last three years in which three jets of Indian Airlines and two aircraft of Vayudoot

were involved in which a few hundred precious lives were lost, there is a growing concern amongst the travelling public of this country that all is not well with air safety. While it is appreciated that strenuous efforts are being made by the DGCA in inculcating a sense of discipline amongst the air crew and improving the maintenance standards of the airlines, it cannot be gainsaid that there are limitations to the DGCA due to various constraints which have been pointed out elsewhere in this report. Observations have also been made on the functioning of the Directorate of Flight Safety in the airlines. A new dimension is getting added to the aviation sector of this country by the opening up of the skies to the private air taxi operators. It is understood that most of these operators are using relatively older generation of aircraft procured on lease from outside India. It has also to be appreciated that a very careful watch has to be kept on the operation of these air taxies as they would not have all the facilities required for excellence in maintenance and adequacy of air safety.

Taking all these factors into account, it is considered necessary particularly in the context of growing volumes of air traffic in the country and the travelling public must also be well informed and be apprised of the measures taken by the Government, the regulatory authority and the airlines ought to ensure their safety. It has also to be noted that unlike in the case of other modes of transport, a major air accident could also affect innocent citizens on the ground. In order to achieve the purpose of having a close interaction between the people who use air travel and those who provide it, apart from the regulatory body which cannot always inter-act with the public, it is considered necessary to form a body consisting of experts, prominent members of the travelling public and those involved in the investigation of air accidents who could periodically meet and have intensive inter-action with all the agencies connected with the air travel such as the DGCA, the Airports Authorities, the Airlines and above all the Ministry of Civil Aviation. It is to be noted that this body would not otherwise involve itself in the day-to-day functions, but would function as a

body to improve the air safety in the country and the periodic inter-action with all agencies connected with air travel would enable also the travelling public to feel confident that all agencies are taking adequate steps and measures to ensure their safety.

15. FINDINGS OF FACTS :

1) The aircraft had valid Certificate of Airworthiness and was maintained in accordance with the approved maintenance schedules. The aircraft was fully airworthy prior to its departure from Calcutta and during the course of the entire flight.

2) The flight crew had appropriate and valid licences to operate the flight. Both the pilots have been medically fit throughout their flying career.

3) The weather at Imphal at the time of crash was - visibility 7 Kms., Clouds 3/8 800 feet, 5/8 1800 feet, 1/8 cb 3000 feet, 8/8 10,000 feet - which was above the operator's weather minima for an ILS approach at Imphal.

4) The ATCO had passed to the aircraft the weather prevailing at 0630 UTC but had not passed the weather of 0700 UTC which was same as of 0630 UTC except that 1/8 cb 3,000 feet was not prevailing at 0630 UTC. The cb was however, located in the North-East direction of the airport whereas the aircraft approached form South-West direction. The upper wind at 3.1 Kms (10,160 feet) estimated by India Meteorological Department at 0600 UTC was 120°/10 Knots.

5) The landing and navigational aids (ILS, VOR & NDB) at Imphal Aerodrome were functioning normally on the day of the accident. Locator Beacons at ILS markers however, have not been provided. The last calibration was effected on 5th June, 1991 and was valid on the date of the accident.

6) Status indicator lights of ILS were not functioning in the Control Tower on the day of the accident and had, in fact, been in such a state for quite some time past.

7) DME co-located with VOR had not been installed till the day of accident even though NAA had received the equipment at Imphal in July, 1991. The DME, however, was subsequently installed and made operational on 29th November, 1991.

8) Distance Measuring Equipment (DME) is a helpful navigational aid but cannot be termed to be an essential navigational aid. Non-availability of DME at Imphal has not contributed to the accident.

9) Installation of Automatic Direction Finder - AD-200 at Imphal Airport is not considered necessary on the threshold of 21st century, more so by reason of the availability of VOR which is a modern navigational and more effective pilot interpreted aid.

10) At Imphal there is no equipment installed to provide Runway Visual Range information which would be of great assistance to the pilots for carrying out instrument approach and landing during unfavourable weather conditions.

11) ATC multi-channel tape recorder supplied by Stencil Hoffman of USA was procured by National Airports Authority and received at Imphal in early 1983, but has not yet been installed even after nine years of procurement.

12) By reason of non-availability of the ATC tape at the Control Tower at Imphal, performance monitoring of ATCOs has become an extremely difficult.

13) ATCOs are not having sufficient familiarisation flights.

14) Air Traffic Control at Imphal Airport on the day of the accident was manned by an officer not formally rated by National Airports Authority, though the concerned ATCO had been informally authorised to handle the air traffic by a senior officer at Imphal.

15) The Senior Aerodrome Officer being a formally rated Air Traffic Controller, was available at the aerodrome but not at the Control Tower at the time of the crash.

16) No refresher courses are arranged by National Airports Authority for their Air Traffic Controllers.

17) Licensing of Air Traffic Controllers has not yet been effected.

18) Licensing of aerodromes also has not yet been effected.

19) There are no maintenance schedules for ground navigation, communication and landing aids.

20) The flight crew did not adhere to the operational flight plan after coming overhead Comilla. They did not go overhead Agartala VOR and instead flew almost directly to Imphal from Comilla.

21) The flight crew gave incorrect call-out to Agartala ATC that they were overhead Agartala VOR even though the aircraft was nowhere near Agartala VOR.

22) The flight crew commenced descent nearly 10 minutes before the top of descent prescribed in the operational flight plan without realising that the same would result in a change of Estimated Time of Arrival.

23) The flight crew requested Imphal ATC for setting course directly outbound for ILS let down, which was cleared by the ATC. This was procedurally a wrong call-out by the flight crew. Permission by the Air Traffic Controller for direct outbound could not possibly have misled the pilot not to come overhead VOR.

24) The flight crew gave wrong altitude call-outs to Imphal ATC on a number of occasions during descent and let down which can only be termed as an act of indiscipline.

25) The aircraft never came overhead Imphal VOR even though the ATC had asked it to report overhead.

26) The flight crew reported approaching overhead VOR even though the aircraft was about 14 miles away from Imphal VOR at that point of time.

27) The flight crew had initially intimated to Imphal ATC the estimated time of arrival as 07:16 hours UTC. However, after setting course directly to Imphal from Comilla they revised their ETA to 07:12 hours UTC.

28) The possibility of the flight crew being misled by reason of false indication of the VOR is ruled out.

29) The flight crew by virtue of not reporting overhead VOR and turning right much shorter of the same, instead of turning left overhead VOR for tear drop entry, lost the time reference required for carrying out ILS let down.

30) Till the time of impact the aircraft was not on localizer or glide path.

31) There was total lack of discipline and professionalism during the flight on the part of the flight crew by not adhering to the operational flight plan as also the ILS let down chart together with wrong position reports and altitude call-outs.

32) The Pilot-in-Command did not adhere to the ILS let down chart but instead seems to have relied upon the ground features with which he thought he was extremely familiar.

33) The flight crew committed a grave error of not realising that early commencement of descent to 10,000 feet and turn to right without coming overhead VOR would misplace them in the hilly terrain further away from the airport.

34) No emergency condition was communicated by the flight crew during the entire course of flight till the time of impact.

35) The co-pilot throughout the flight remained as a mere passive and mute spectator to the deviations from the prescribed operational procedures.

36) Tail wind of even 60 knots during outbound leg could not have drifted the aircraft to the place where the crash has taken place if the ILS let down procedure was adhered to.

37) About six seconds prior to the impact, GPWS warning came 'ON', but it was not possible to clear the hill ahead even if the crew had taken immediate action to climb.

38) The crash occurred on the Thangjing Hill about 300 feet below the hill peak and at a distance of 20.19 nautical miles from VOR Imphal Airport as per the distance estimate given by the Directorate of Survey (Air).

39) There was no evidence to indicate any sabotage or inflight structural failure of the aircraft.

40) Search and rescue operations were carried out in a manner as is expected in the circumstances as were prevalent on the date of the accident at crash site.

16. PROBABLE CAUSE OF THE ACCIDENT

The accident occurred by reason of a grave error on the part of the Pilot-in-Command in not adhering to the operational flight plan and ILS let down chart and not realising that his early descent to 10,000 feet and turning right for outbound leg without reporting overhead VOR would result in loss of time reference and as such misplace him in the hilly terrain. The Pilot-in-Command's action may have been influenced by his extreme familiarity with the terrain.

17. RECOMMENDATIONS

1) The Indian Airlines should reiterate to all its pilots that they must meticulously follow all stipulated operational procedures.

2) The Flight Safety Directorate of Indian Airlines should be restructured so as to introduce a flight standardisation cell which would be responsible for surveillance checks on board the aircraft as also simulator training and monitoring of other related operational aspects. This should, however, be in addition to the routine proficiency checks as is prevalent.

3) The operator should carry out random checks of Cockpit Voice Recorder, Flight Data Recorder and Digital Flight Data Recorder and the DGCA should ensure compliance thereof.

4) The training programme of the operator ought to inculcate a sense of cockpit discipline amongst the pilots in order to ensure smooth and efficient operation of the flight with meticulous observance of stipulated procedures.

5) Indian Airlines training programme should emphasise the need for correct call-outs by pilots and under no circumstances the pilot should indulge in wrong and inappropriate call-outs.

6) The Indian Airlines training programme ought to provide that the pilots should be guided by available navigational aids rather than the visual ground fixes specially on an IFR flight.

7) Indian Airlines should include an exercise in the syllabus for simulator training as regards the pilot's reaction to the triggering of the GPWS.

8) Co-pilots training ought to match with that of the Pilot-in-Command since the former is acting as a safety pilot and may be required to take charge should it be so required.

9) The operator ought to hold flight safety meetings regularly and the entire Directorate of the operator requires restructuring and revamping so as to be more effective in the matter of flight safety.

10) Periodic meetings between the Operations Manager, Flight Safety, and the Line Pilots ought to be arranged so as to derive benefit from the experiences of other pilots.

11) Proper liaison be maintained between the Flight Despatch, Operational Personnel including engineering and the Flight Safety Directorate of the operator by way of meetings at regular intervals.

12) The career pattern of pilots as is existing today with the operator (Indian Airlines) ought to be reviewed in the light of observations made in the report.

13) The operator through their training programme ought to encourage and impress on junior pilots and convince them that they not only have the right but indeed have the responsibility to speak up if they disagree with senior pilot's action. They must be reassured that they will not suffer displeasure or recrimination for doing so.

14) The senior pilots must equally be told that if they do not accept or indeed ridicule a junior pilot's actions in this regard then their own behaviour is unacceptable to the airline.

15) The operator must inculcate in the whole body of the pilots the philosophy of team work while operating a flight.

16) Cockpit Resource Management Course ought to be introduced without any further loss of time and if necessary even an outside management consultant may be approached for proper and effective guidance in regard thereto and all pilots are to undergo the same course in order to promote better cockpit management for safe flight operations.

17) The cabin crew training programme should be standardised and no departure from the prescribed training syllabus ought to be permitted.

18) The operator should ensure that all mandatory documents are upto date and carried on board. The DGCA Airworthiness Officers should carry out random checks and monitor compliance of the same.

19) All Boeing 737 Aircraft operating in the country and registered by the Director General of Civil Aviation should be fitted with Digital Flight Data Recorder as also Emergency Locator Transmitters capable of impact as well as water activation.

20) Calcutta Airport being a major Boeing 737 aircraft maintenance base, ought to be provided with all necessary spares and trained personnel for effecting proper checks upto Check-I level so as to avoid carrying forward of any snag and for other similar stations the situation ought to be reviewed forthwith.

21) Proficiency checks of Air Traffic Controllers should be carried out periodically at least once a year and the Air Traffic Controllers should also undergo refresher courses once a year.

22) The performance of the ATCOs ought to be monitored regularly by the National Airports Authority and all remedial measures be taken immediately and if required further training be arranged for without any financial repercussions.

23) Periodic monitoring of ATC tape so as to check the proficiency of ATCOs should be conducted by the National Airports Authority and the DGCA should also monitor the same by way of random checks.

24) The National Airports Authority should arrange for familiarisation flights for all ATC personnel more frequently in consultation with the operators operating in the country.

25) Periodic medical check-ups of ATCOs ought to be introduced immediately.

26) National Airports Authority should envisage specific duty hours for the ATCOs taking into consideration the fatigue factor.

27) The training programme of ATCOs ought to contain a syllabus through which the ATCOs can familiarise themselves with the cockpit instruments relating to navigational and ground aid facilities.

28) National Airports Authority should carry out calibration of all navigational and landing aids at the frequency stipulated by ICAO.

29) National Airports Authority should ensure that only trained and formally rated Air Traffic Controllers handle the traffic.

30) National Airports Authority should clearly lay down the duties and responsibilities of Aerodrome Assistants and Air Traffic Control Officers.

31) Search and rescue ought to be included in the syllabus for training of appropriate personnel by the National Airports Authority.

32) Status indicator lights ought to be maintained in serviceable condition at all times in all airports without any differentiation.

33) Locator beacons at ILS markers may be provided at Imphal airport and also at other hilly terrain airports.

34) ATC tape recorder ought to be provided at Imphal Airport without any further loss of time. As a matter of fact, this particular facility should be made available to all airports having scheduled Airline operations.

35) The National Airports Authority would be well-advised to prepare periodic maintenance schedules for all navigational, communication and landing aids and safety services. Periodic checks be carried by only trained personnel.

36) As far as practicable there should be two Air Traffic Controllers available at the Control Tower during the flight movements at least at stations where all ATC functions are combined in one unit as also at the Area and Approach Control Units where radar facility is available.

37) The National Airports Authority must make available the instrument let down charts to the DGCA for its approval.

38) Instrument let down charts of airports specially in the hilly terrain ought to be reviewed by National Airports Authority in consultation with the operator and seek the approval of DGCA.

39) Necessary equipment should be installed by the Meteorological Department for assessment of runway visual range as also cloud base at Imphal Airport as also other airports in hilly terrain.

40) The Flight Inspection Directorate of DGCA should be restructured to carry out frequent proficiency checks of the airline pilots on various types of aircraft and the ATCOs.

41) The Air Safety Directorate of DGCA should be strengthened to make it more effective in discharge of its vital functions relating to safety of aircraft operations.

42) The one man Accident Prevention Cell currently existing in DGCA is totally inadequate to discharge the vital role of accident prevention and as such it should be restructured and strengthened without any loss of further time.

43) DGCA should have an separate air accident prevention cell manned by persons not below the rank of Senior Air Safety Officer at every major airport of the country.

44) The implementation of the earlier recommendation in regard to licensing of ATCOs and Aerodromes should be effected forthwith by creating an adequately staffed new wing in the Office of the Director General of Civil Aviation.

45) The DGCA should ensure inspection of the aerodromes at least once in two years.

46) DGCA should coordinate meetings with the Operators and the National Airports Authority in regard to Flight Safety inclusive of engineering aspects.

47) The DGCA being the regulatory authority ought to be revamped so as to be able to discharge its regulatory functions

in terms of the Aircraft Act and the Rules framed thereunder effectively.

48) Director of Airworthiness of DGCA should exercise strict supervision by carrying out more frequent spot checks for better quality control in all relevant areas.

49) The DGCA ought to review the Minimum Equipment List periodically and monitor its usage particularly in regard to snag detection within a period of one hour prior to the departure.

50) The Central Government would be well advised for formation of an independent Air Safety Board as discussed in the report.

(Umesh C. Banerjee) 30th April, 1992
JUDGE : HIGH COURT, CALCUTTA

We agree with the Findings, Cause of Accident and the Recommendations made in this report as above.

(B.P. Baliga) 30/4/1992
Assessor

(Wg Cdr. P. Ashoka)
Assessor

ACKNOWLEDGEMENT

Before closing this report my sincere thanks go to the Assessors Shri B.P. Baliga, Retd. Director of Engineering, Air India and Wg. Cdr. P. Ashoka, a very renowned test pilot of the country for their valuable assistance in this matter. It has been a real pleasure to be associated with such eminent persons in the aviation industry of the country.

Before I record my appreciation to the Indian officials, my sincere thanks go to the Civil Aviation Authority, Australia and to Qantas Airways as also to the Civil Aviation Authority of Singapore. The manner in which both the above noted authorities and the Airline assisted me, is something to be remembered for long time to come. I do not feel shy to record that Qantas culture has opened a new vista in my knowledge of aviation and I hereby record my appreciation therefor. My sincere thanks go to Maurie Baston, Tony Allison, Mick Vaughan and Ronald J Yates of the Civil Aviation Authority, Australia. I am indeed happy to have met Capt. John Faulkner, Manager Flight Safety, Qantas Airways more so by reason of his untiring effort in coordinating the whole programme of study of the Qantas culture and I record my sincere thanks to John for the same. My thanks also go to Capt. Ray Heiniger, Deputy Chief Pilot; Ken S. Lewis, Head of Safety; Kerry F. Lumsdon, Quality Assurance Controller; R.W. Alcorn, Manager of Aircraft Engineering and David Cormack, Manager Operations Training Services. The hospitality of both the CAA Australia and Qantas knew no bounds and in this context my sincere thanks also go to the Deputy Chief Executive, Qantas Airways.

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The sincerity with which the manufacturer of the aircraft, namely, Boeing Company responded to the queries of this Court of Inquiry needs special praise. The Company never showed any reluctance to assist the Court in every sphere. Special representatives were sent to meet me both at Delhi and at Calcutta and the exercises undertaken at the request of the Court cannot but be praiseworthy. Mr. James Kerrigan an Aeronautical Engineer was specially flown from USA to Calcutta for the purpose of assisting this Court of Inquiry by his oral evidence and documentary presentation before the Court. I record my appreciation to the Company for such assistance.

Capt. D.S. Mathur, Director Operations, Air India, and Capt. J.R. Trilokekar, Deputy Director Operations, Air India, were troubled by me on more than one occasion, but their sense of duty and sincerity for the purpose prompted them to bear with me ungrudgingly and I record my appreciation and sincere thanks for their invaluable service to this Court of Inquiry specially for taking the trouble of simulating the flight path on the basis of the flight data of the ill-fated aircraft and other flight datas on more than one occasion.

During the course of investigation, I came to know Shri H.S. Khola, Deputy Director General of Civil Aviation more closely and in him I find an efficient, knowledgeable, devoted and hard-working official of the Central Government. I sincerely wish him all success in life and pray to Almighty that Shri Khola should continue to act with such devotion for all times to come.

I will fail in my duty if I do not mention the untiring effort of Shri Satendra Singh, Director Air Safety in the Office of the Director General of Civil Aviation. In him I find an ever-obliging gentleman who is not only hard-working but sincere to its core and I also wish him all success in life.

Shri R.K. Paul, Regional Controller of Air Safety, Calcutta, and the Inspector of Accident in this case has left a very deep impression in my mind for his sincerity and hard-work together with his desire to fulfil all the needs of the Court. Shri Paul has helped me to an enormous extent to bring to a fruitful end of the task assigned to me. The report submitted by him is also very comprehensive and assisted me in every sphere of my inquiry.

Shri A.K. Sinha, the Secretary of this Court of Inquiry has also been of very great assistance to me. Troubled as he was during the entire course of Inquiry, he never lost his patience. His profound knowledge of Air Traffic Control System has also left a deep impression in my mind.

In the body of the report I did mention about the effort of Manipur Adventure and Allied Sports Institute (MAASI), in the matter of search and rescue. I sincerely hope and pray to Almighty that Shri N.J.K. Singh along with his young friends should continue to render this type of invaluable humane service and I wish the organisation all success.

My sincere thanks also go to the Border Security Force personnel as also the personnel of Manipur Rifles and Central Reserve Police Force, without whose assistance the search and rescue would have been a near impossibility. I also record my sincere appreciation of the services rendered by the Indian Air force in providing all necessary assistance including helicopters for rescue work as also for location of the crash site to this Court of Inquiry.

My thanks also go to the staff of the West Bengal Legislative Assembly as also the staff of the Manipur Government Circuit House at Imphal for all their administrative assistance and courtesies extended to me and to the other members of this Court of Inquiry.

I will be failing in my duty if I do not record my sincere appreciation of the services rendered by Shri Lalit Gupta and Shri R.K. Kohli in the Office of the Director General of Civil Aviation, without whose assistance this report could not have been prepared within the target date. The untiring energy of these two young gentlemen needs special mention and praise.

While I thank all the lawyers who have assisted the Court in its Inquiry, I record my special appreciation for the assistance rendered by Capt. S.L. Bagchi, Capt. Mulherkar, Shri K.K. Saxena and Shri Dasgupta for their invaluable service to this Court of Inquiry. I must also record my very great appreciation to Mr. Roy Choudhury being the father of Late Capt. D.B. Roy Choudhury for his assistance to this Court of Inquiry in the matter of identification of voice. Mr. Roy Choudhury, grief-stricken as he was by reason of the loss of his son, did come forward to assist the Court - an indeed laudable gesture.

Finally my deepest condolences to the members of the bereaved families both of crew and of the passengers.

30th April, 1992

(Umesh C. Banerjee).
Judge : High Court, Calcutta