REPORT
OF
COURT OF INQUIRY
on
MID-AIR COLLISION
BETWEEN
SAUDI ARABIAN BOEING 747
AND
KAZAKHSTAN IL-76
on
12th November, 1996
NEAR DELHI - INDIA
(CHARKHI-DADRI, HARYANA)

By

JUSTICE R.C. LAHOTI
Judge High Court of Delhi

GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION

MINISTRY OF CIVIL AVIATION

DECISION OF THE GOVERNMENT OF INDIA ON THE REPORT OF COURT OF INQUIRY OF MID-AIR COLLISION BETWEEN SAUDI ARABIAN BOEING 747 AND KAZAKHSTAN IL-76 AIRCRAFT NEAR DELHI ON 12TH NOVEMBER, 1996

A Saudi Arabian Boeing 747 aircraft and Kazakhastan IL-76 aircraft collided in mid-air about 40 miles west of Delhi on 12th November, 1996. All the 312 occupants of Saudi Boeing 747 and 37 occupants of Kazakhstan IL-76 aircraft lost their lives. The Saudi Boeing 747 aircraft was on a scheduled passenger flight from Delhi to Dahran and the Kazakhastan aircraft was operating a non-scheduled flight from Chimkent, Kazakhastan to Delhi. After take off from Delhi, Delhi Approach had instructed the Saudi Boeing 747 aircraft to climb and maintain FL-140 (14,000 feet). The Kazakhastan aircraft had been instructed by Delhi Approach to descend and maintain FL-150 (15,000 feet). Suddenly at 1840 hours the blips of the two aircraft disappeared from the radar screen, as the two aircraft had collided. There was no casualty on ground. The wreckage of Saudi Boeing 747 aircraft fell near village Dhani in Bhiwani District of Haryana and that of Kazakhastan IL-76 aircraft was lying near village Birohar in Rohatak District. Standing crops at the site of accident were damaged due to fire, impact and rescue operations.

Government appointed Justice R.C. Lahoti, Judge High Court of Delhi to carry out a formal investigation into the accident under Rule 75 of the Aircraft Rules, 1937. The Government also appointed Capt. A.K. Verma, Director Air Safety, Air India and Air Cmde. (Retd) T. Pannu, Ex-Director Operations (ATC), IAF to act as Assessors to the said Court of Inquiry. The report of the Court of Inquiry was received on 15th July, 1997.

The Court has concluded the cause of the accident as under:

> "The root and approximate cause of the collision was the unauthorised descending by the Kazak aircraft to FL-140 and failure to maintain the assigned FL-150."

The Government have accepted the report of the Court of Inquiry and the cause of the accident as determined by the Court of Inquiry. The Court of Inquiry has made 46 findings. The findings have been accepted as indicated in Annexure-I.

The Court of Inquiry has made 15 recommendations. The recommendations made by the Court of Inquiry, which aim at enhancing the safety of aircraft operations, have been broadly accepted for implementation. Explanatory comments for implementation of these recommendations are given in the Annexure II.

Annexure-I

MID AIR COLLISION BETWEEN SAUDI ARABIAN BOEING 747 AND KAZAKHSTAN IL-76 AIRCRAFT ON 12TH NOVEMBER, 1996

FINDINGS	COMMENTS/ACTION TAKEN
5.1 Facts not in Controversy The following factual details are either not in dispute or have been well established (Chapter II):	
a) The Kazakhstan aircraft Ilyushin IL-76 TD No-UN-76435 was owned by the Shymkent Avia Kazakhstan, a sister concern and subsidiary of Kazakhstan Airlines. The aircraft was on a non-scheduled chartered flight from Chimkent to Delhi on 12.11.1996.	Noted.
b) The IL-76 aircraft had a certificate of airworthiness issued by the Republic of Kazakhstan, valid upto 31.7.1997	Noted.
c) The IL-76 aircraft took off from Chimkent on 12.11.1996 at 10.25 UTC for Delhi. The flying time was about 3 hrs. There were 37 persons on board, including 5 cockpit crew and five cabin crew.	Noted.
d) The IL-76 aircraft was under the command of Capt. Alexander Rohertovich Cherepanov (PIC). The second pilot was Ermek Kozhahmetovish Dzhanbaev (P2). In addition, there were a Flight Engineer (FE), Navigator (N) and a Radio Operator (R) as part of the cockpit crew. All of them had respective licenses.	Noted.

REPORT
OF
COURT OF INQUIRY

on

MID-AIR COLLISION

BETWEEN

SAUDI ARABIAN BOEING 747

AND

KAZAKHSTAN IL-76

on

12th November, 1996

NEAR DELHI - INDIA

(CHARKHI-DADRI, HARYANA)

By

JUSTICE R.C. LAHOTI

Judge High Court of Delhi

Assessors

Capt. A.K. Verma
Director-Air Safety Air India.

Air Cmde (Retd) T. Pannu
Ex-Director Operations (ATC) IAF

Secretary

V.K. Arora
Controller of Airworthiness
Directorate General of Civil Aviation

e)	The IL-76 aircraft came in first contact with Delhi Approach at 13.04.55 and reported passing FL230 and 74 miles from DPN (Delhi). As per AAIB-DFDR time (page 00213) this transmission was 315.1 sec before collision that is to say 13.05.01 (IAC time). The IL-76 was cleared by the Delhi Approach to descend to FL 150 at 13.05.06 and this was acknowledged by the aircraft at 13.05.16 five minutes before collision.	Noted.
f)	At 13.08.54 the D-APP asked the IL-76 for the distance from DPN and the aircraft responded at 13.08.59 "Kazak-1907, now reached one five zero, four six miles from Delta Papa November (DPN), Radial two seven zero." As per AAIB-DFDR recordings the IL-76 was, however, at about 16439 ft at 13.08.59 (77 secs before collision).	Noted.
g)	From 13.08.69 to 13.09.41 the IL-76 and the D-APP were in continuous two-way contact, during which time D-APP asked the IL-76 to maintain FL 150 which the aircraft acknowledged. The D-APP also informed the IL-76 of the reciprocal Saudi Boeing at FL 140. In response to the D-APP asking the IL-76 to report if the Boeing is in sight, the IL-76 responded at 13.09.41, "Now looking 1907". This was the last transmission from the IL-76 to the ATC.	Noted.
h)	The entire communication from the IL-76 aircraft to the ATC was by the Radio Operator and it was in English.	Noted.

i)	The Saudi Boeing-747 aircraft HZ-AIH belonged to the Saudi Arabian Airlines. The aircraft was of 1982 manufacture and was airworthy as per certifications.	Noted.
j)	The Saudi Boeing-747 was on a scheduled flight from Delhi to Dahran and took off from IGI Airport Delhi at 13.03 UTC on 12.11.1996. There were 312 persons on board including 3 cockpit crew and 20 cabin crew.	Noted.
k)	The Saudi Boeing-747 was under the command of Capt. Khalid A AL-Shubaily (PIC) and the first officer was Nazir Khan (P2). The third member of the cockpit crew was the Flight Engineer (FE). All the crew members had respective licenses.	Noted.
l)	The Boeing got airborne at 13.02.50 (AAIB-DFDR time) corresponding to 1303 ATC time. On departure the aircraft was identified on radar and thereafter remained under the control of Delhi Approach Control.	Noted.
m)	Initially the Boeing was cleared by ATC to climb to FL 100 and at 13.06.13 the aircraft was cleared to climb to FL 140. The aircraft reported approaching FL140 at 13.08.41 and the ATC asked the aircraft at 13.08.44 to maintain FL 140, and standby for higher. At 13.08.52 the Saudi Boeing acknowledged Saudi seven six three (will) maintain one four zero" (AAIB Report page 00216). This was the last transmission from the Saudi aircraft to the ATC.	Noted.

n)	Neither in the CVR nor in the DFDR of both the aircraft is there any indication or evidence of any evasive or avoidance action having been taken by the respective crew. During the entire period when the Delhi ATC was in contact with the two aircraft there has been no transmission from either of the aircraft to the ATC of any abnormality observed or of any real/anticipated emergency.	Noted. Intra-cockpit conversation in the Kazak IL-76 aircraft four seconds prior to collision shows that the Radio Officer had seen the Saudia B-747 aircraft before impact. Intra-cockpit conversation reads as : "Get to 150, because on the 140th, uh that one uh .....!" Similarly, ATC tape transcript shows that the flight crew of Saudia had called "Astaghfor Allah, Ashhau Unlaelaha Ella Allah" means God forgiveness, I witness no other God but Allah.
o)	The two aircraft collided at about 14000 ft level and at 13.10.16 UTC (IAC Moscow Report) time.	Noted.
p)	There were no survivors. There was no casualty on the ground.	Noted.
q)	Both the aircraft disintegrated in the air after the collision and caught fire.	Noted.
r)	The wreckage was found spread in a trail of 7 kms, 2 kms wide, about 40 NM away west of IGI Airport, Delhi.	Noted.
s)	Rescue action was initiated immediately by the local police and the civil authorities and this was followed by the rescue teams from Delhi.	Noted.
t)	All Navigation aids and communication equipment at the IGI airport were serviceable at the relevant time on 12.11.1996.	Noted.

5.2 Findings as to Main Issues

Based on the material available and its appreciation the Court arrives at the following findings:

a)	The Mid-air Collision was not caused (directly or indirectly) by sabotage, internal explosion or by any cause external to the crew or the aircraft.	Noted.
b)	The accident was not caused by any mechanical failure or mechanical defect of any of the two aircraft.	Noted
c)	Both the aircraft were fully airworthy and free from any mechanical/ technical defect.	Noted.
d)	The two aircraft collided at flight level 140 (i.e. 14,000 feet). (Para 4.10).	Noted.
e)	The Saudia B-747 had been assigned FL-140 whereas the Kazak IL-76 was assigned FL-150 for a safe crossing on the reciprocal tracks. (Appendix D).	Noted.
f)	Vertical separation of 1,000 feet for the crossing of the two aircraft as assigned by the Delhi Air Traffic Control was adequate and met the ICAO standards of safety. (Para 4.32).	Noted.
g)	The Saudi Aircraft meticulously maintained FL-140. (Appendices C-3 and D).	Noted.
h)	The Kazak Aircraft descended to FL-140 (departing from the assigned FL-150) just prior to the anticipated crossing. (Appendices B-2(T), C-3 and D).	Noted.

i) **The root and approximate cause of the collision** was the unauthorised descending by the Kazak aircraft to FL-140 and failure to maintain the assigned FL-150. (Para 4.22).

Noted. Kazakhstan Government would be informed of the cause of the collision for taking necessary action.

j) The factors contributing to the unauthorised descent of Kazak aircraft to FL-140, departing from the assigned FL-150, were (Para 4.22):-

Noted. Kazakhstan Government would be informed for taking necessary remedial action on all the four contributory factors by their airlines.

i) inadequate knowledge of English language of Kazak pilot, resulting in wrong interpretations of ATC instructions.

ii) poor airmanship and lack of proper CRM (Crew Resource Management) skill on the part of PIC (Pilot-in-Command) compounded by leadership quality lacking in him.

iii) Casual attitude of the crew and lack of coordination in the performance of their respective duties by crew of Kazak aircraft.

iv) Absence of standard call-outs from any crew member.

(NB: Crew Resource Management includes crew coordination, situational awareness, quality of leadership, intra crew communication)

k) Nearly 30 seconds before collision both the aircraft had entered a cloud layer and experienced turbulence of weak to moderate intensity. The presence of the cloud did result in

Noted.

	reduced visibility conditions. But the cloud did not cause any such severe turbulence as to result in an abrupt loss of altitude to the extent of 1000 ft. pertaining to the level of Kazak aircraft. (Para 4.26).	
l)	ATC instructions to both the aircraft were clear and proper and in accordance with established procedures. (Para 4.32).	Noted.
m)	Direct pilot-controller communication was not established by Kazak 1907 with Delhi ATC. (Para 4.20)	Noted. Instructions would be issued that only pilots of the aircraft to communicate with ATC.
n)	Presently SSR is not available at Delhi airport. However, installation of current generation radar (both primary and secondary) along with other ATC automated systems is already in progress. (Para 4.38)	Noted. New ATC System has already been installed at Delhi. AAI is taking all possible action to expedite commissioning of the new ATC systems at Mumbai.
o)	Single air corridor (bi-directional ATS route) at Delhi airport was not a contributory factor for accident. However, availability of uni-directional routes does enhance ATC's traffic handling capacity, which is in the national interest. (Para 4.37.3)	Noted. ATS route G-452 on which the accident took place has been made unidirectional with effect from 14th August, 1997. Additionally, ATS route A-466 has also been made unidirectional and action is in hand to make route R-460 also unidirectional.
p)	Outcome of the investigation by DGCA/AAI into airmiss incidents is not being disseminated to the air traffic controllers from the training point of view. (Para 4.42.5)	Noted. The system of disseminating information would be reviewed in the light of the finding.

5.3 Findings as to Incidental Issues

a)	Altitude parameter accuracy limits in respect of FDR installed in IL-76 were not in accordance with those laid down in ICAO Annex-6 Part I (Table D1 of Attachment). (Para 4.44).	Noted. Kazakhstan Government would be informed of the findings so that necessary action could be taken by them to ensure the accuracy of DFDR parameters is in accordance with the ICAO standards.
b)	Both Boeing 747 and IL-76 were not equipped with Airborne Collision Avoidance System (ACAS). Para 4.45)	Noted. Civil Aviation Requirement has already been issued by DGCA for the installation of Airborne Collision Avoidance System (ACAS). Both Saudi Arabian and Kazakhstan Governments have been asked to ensure adherence of the CAR by their airlines while flying in India.
c)	IL-76 was not equipped with i) Altitude Alert System, and ii) Altitude Acquisition System.	Noted. Kazakhstan Government would be informed to initiate the remedial action in this regard by their airlines.
d)	In the organisational set-up of DGCA (India) there is no ATC element to oversee ATC aspects which presently fall under the purview of Airports Authority of India (AAI) Para 4.44)	Noted. Restructuring of DGCA is already under consideration and a new Directorate is planned to be created to oversee ATC aspects and to licence the Air-Traffic Controllers as recommended by the Court (Recommendation No. 6.9 & 6.14).
e)	In the organisational set-up of AAI, the highest post which an ATC professional can fill up is that of Executive Director (Air Traffic Management) which arrangement is not adequate. (Para 4.50)	Noted. The post of Member looking after ATC and communication in AAI already exist as Member (Operations). The post is open to the officers of ATC discipline subject to the usual selection process and procedures through PESB.
f)	Present system of civil/military ATC coordination in India Suffers from Serious short-comings, which adversely affect air safety in India. (Para 4.50)	Noted. A High Level Apex Committee exists with Chairman, Airports Authority of India, DGCA and Assistant Chief of Air Staff as the Members for civil/military ATC coordination. Meetings are also being held by Secretaries of Civil Aviation and Ministry of Defence to improve coordination.
g)	In India, the ATC profession, which has become highly specialized due to the present day complex flying environment, does not enjoy the recognition and status it deserves.	Airports Authority of India was constituted by an Act of Parliament for the management of airspace and provision of air traffic services in India in addition to other related functions. Provision and management of ATC is a major function of the Airports authority of India and

			at present there is no need for creating another organisation for ATC. Within the AAI, ATC works as a recognised discipline with an independent cadre.
h)	i)	Working conditions at Delhi Airport ATC (present complex) are not upto the desired standards. (Para 4.52)	Airports Authority of India had examined the requirements of air traffic services to be established at Delhi under the modernisation of ATC. Keeping in view the expected increase in traffic, it has provided for expansion of Area Control Centre to 4 sectors instead of the 2 sectors at present and bifurcation of Approach Control as and when the demand of traffic would justify and bifurcation and expansion.
	ii)	Working space in the new complex specially with regard to Area/Approach Control, ATC Simulator and IAF element is not adequate to match their functions.	
	iii)	Further in view of the anticipated increase in air traffic, the present number of work stations is not considered adequate. (Para 4.52.5)	
i)		In India, there is no system of licencing of air traffic controllers. Also the proficiency standards which are being followed in civil and military ATC are not uniform. (Para 4.53)	Noted. A new directorate would be created in DGCA for licensing of Air Traffic Controllers. Ministry of Defence would also be asked to follow ICAO procedures for the Air Traffic Controllers who handle civilian air traffic.
j)		Just a One-man accident/incident prevention cell in DGCA is not adequate.	Noted. Restructuring and strengthening of DGCA is already under consideration and Government is examining the report submitted by Seth Committee.

MID AIR COLLISION BETWEEN SAUDI ARABIAN BOEING 747 AND KAZAKHSTAN IL-76 AIRCRAFT ON 12TH NOVEMBER, 1996

	RECOMMENDATIONS	COMMENTS/ACTION TAKEN
6.1	The requirement of proficiency in English, which is the language accepted by ICAO for radio communications on international flights, should be strictly ensured by contracting States. ICAO should devise ways and means to ensure such compliance by contracting States so as to avoid lapses in their part.	Accepted. The matter would be taken up at ICAO at an appropriate level. Kazhastan Government would also be asked to ensure that their pilots are proficient in English for radio communication on their international flights to India.
6.2	Meaningful Crew Resource Management Programme should be made an integral part of crew training curriculum with special emphasis laid on the importance of standard call-outs and its efficacy be evaluated during periodic licence renewal checks.	Accepted. DGCA has already stipulated that all Indian scheduled operators should have Crew Resource Management (CRM) programme as an integral part of crew training with special emphasis on standard call-outs. Both Saudi Arabian and Kazakhstan Governments would be informed about the recommendation of the Court so that necessary action can be taken by their airlines also. The matter would be taken up with ICAO for implementation of the recommendations.
6.3	Before a pilot is appointed as "Pilot-in-Command" his having acquired effective CRM skill and qualities of leadership should be meticulously ensured.	Accepted. Regulatory requirements are being promulgated for endorsement as Pilot-in-Command, to ensures that the pilot has acquired CRM skill and the qualities of leadership. Both Saudi Arabian and Kazakhstan Governments would be informed about the recommendation of the Court so that necessary action can be taken by their airlines. The matter would be taken up with ICAO to ensure implementation of the recommendation.

6.4	Air-ground communications with ATC may be governed as follows:- a) In general, the emphasis should be on direct pilot-controller communications irrespective of crew composition. b) In the terminal control areas, the requirement should be of direct pilot-controller communication invariably so as to avoid time lag in compliance of ATC instructions. c) In the enroute phase, a crew other than pilots may handle radio communications with ATC subject to basic flying instruments being in his view.	Accepted. Instructions would be issued that only pilots of the aircraft to communicate with ATC.
6.5	AAI should expedite commissioning of ATC automated systems.	Accepted. AAI is taking all possible action to expedite commissioning of the new ATC systems at Delhi and Mumbai. The system has already been commissioned at Delhi on 1st July, 1998 and it is likely to be commissioned by September, 1998 at Mumbai.
6.6	AAI should bifurcate ATS Route G-452 (which is a high density traffic route) into unidirectional arrival/ departure corridors within the limits of Delhi TMA to coincide with the commissioning of ATS automated systems. Other bidirectional routes may also be restructured wherever warranted.	Accepted. ATS route G-452 on which the accident took place has been made unidirectional with effect from 14th August, 1997. Additionally, ATS route A-466 has also been made unidirectional and action is in hand to make route R-460 also unidirectional.
6.7	Use of DFDRs/FDRs not according to the parameters accuracy limits (or having tolerance beyond those	Accepted. DGCA would take up the matter with the other regulatory agencies, specifically with Inter-State Aviation

	recommended) in ICAO Annex-6 Part-I attachment/table D-1 should not be permitted on public transport aircraft by the contracting States. This can be ensured by the regulatory agency of the country of manufacture at the time of issue of type certificate in respect of a DFDR/FDR and by ICAO taking steps to emphasise the need of implementation of its recommendation by the contracting States.	Committee, Moscow to ensure the implementation of the recommendation by Court.
6.8	Public Transport Aircraft should be equipped with: i) Airborne Collision Avoidance System (ACAS). ii) Altitude Alert System. iii) Altitude Acquisition System.	Accepted. DGCA has already issued a Civil Aviation Requirement for installation of ACAS. DGCA would take up the matter with the other regulatory agencies to find out the feasibility of installing the other two systems recommended by the Court.
6.9	Government of India should create a suitable ATC element at a senior level in the DGCA to properly oversee all aspects of ATC.	Accepted. Restructuring/strengthening of DGCA is under review and a Directorate for licencing of Air Traffic Controllers as recommended (Recommendation No. 6.14) would be created in DGCA.
6.10	Airports Authority of India should have a Member (ATC) on its Board to look after ATC matters. Regional/Field ATC units should be placed under unified command of ATC cadre.	The post of Member looking after ATC and communications in the AAI already exists as Member (Operations). The post is open to the officers of the ATC discipline subject to the usual selection process and procedures through PESB.
6.11	Government of India should integrate civil and military ATCs preferably on the pattern of NATS in the UK.	Accepted. There will be greater civil-military liaison for joint surveillance of Indian air space. Integration of Civil/ Military Air Traffic Services will be developed to ensure uniformity in air traffic control services at civilian and defence airports.

6.12	Government of India should recognise due importance of ATC profession and accord special status to it preferably by examining the feasibility of de-linking ATS from the normal organisational set-up and creating an independent cadre to be governed by separate provisions.	Airports Authority of India was constituted by an Act of Parliament for the management of airspace and provision of air traffic services in India in addition to other related functions. Provision and management of ATC is a major function of the Airports Authority of India and at predsent there is no need for creating another organisation for ATC. Within the AAI, ATC works as a recognised discipline with an independent cadre.
6.13	AAI should introduce sectorisation controlling in approach control and re-organise working space in the Delhi airport ATC (new complex) so as to match functional requirements of Area/approach Control, ATC Simulator and IAF element. The adequacy of planned number of work stations in the new ATC should also be reviewed in the light of anticipated increase in air traffic.	Airports Authority of India had examined the requirements of air traffic services to be established at Delhi under the modernisation of ATC. Keeping in view the expected increase in traffic, it has provided for expansion of Area Control Centre to 4 sectors instead of the 2 sectors at present and bifurcation of Approach Control as and when the demand of traffic would justify such bifurcation and expansion.
6.14	Government of India should intro duce the Scheme of licencing for controllers and make it applicable to military, too, so as to achieve uniform standards in controlling.	Accepted. A Directorate for licencing of Air Traffic Controllers (ATCOs) is being created in Directorate General of Civil Aviation. The requirements and procedures to be followed for licencing of Civil ATCOs would also be applicable for licencing of Defence ATCOs.
6.15	Government of India should establish an adequately staffed Accident/ Incident Prevention Directorate in the DGCA so as to enhance the level of safety in civil aviation in India.	Strengthening of DGCA is already under consideration and accident prevention would be strengthened.

CONTENTS

CHAPTER-I

Introduction

CHAPTER - I

INTRODUCTION

1.1 The worst air disaster in India and the third worst in World aviation history took place on 12.11.96 at about 1310 UTC (6.40PM IST) near Delhi. All 349 persons on board were killed when Kazakhstan IL-76 and Saudi Boeing-747 collided mid-air, 40 miles west of the capital. There were 10 crew with 27 passengers on board KZ-1907 and 23 crew with 289 passengers on board SV-763. There were no survivors.

1.2 Kazak aircraft had departed from Chimkent Airport (Kazakhstan) at 10.25 UTC on 12.11.96 for Delhi. It was on a non-scheduled flight supposed to carry tourists to India. Delhi Approach had instructed it to maintain Flight Level 150 (15000 ft).

1.3 Saudi aircraft was on a scheduled passenger flight. It had arrived at Delhi from Jeddah (Saudi Arabia) and was on its return flight to Dhahran (Saudi Arabia). The aircraft departed Delhi Airport at 1303 UTC (6:33 PM IST) from Runway 28 and was cleared via ATS Route G452. Prior to the

collision, Delhi Approach had instructed it to maintain Flight Level 140 (14,000 ft). Suddenly, the two radar blips disappeared from Controller's Screen and his worst fears were soon confirmed. The two aircraft had collided !

A USAF aircraft was on a flight from Islamabad to Delhi via Hissar. It had started descent into Delhi terminal area around 15 minutes prior to the unfortunate accident. It was somewhere between FL 200 and FL 140 (estimated) and was in Visual Meteorological Conditions (VMC) when the pilot saw a cloud lit up with an orange glow at 2 O'clock position from his aircraft. At first he thought it was lightening, but when the glow persisted the lightening was ruled out. As he descended his aircraft near the base of the cloud he saw two fireballs diverging away from each other which then proceeded to hit the ground. The pilot called Delhi Approach and communicated - " We saw something to our right, looks like a big fireball something--- looks like a big explosion." He continued,"We see two fires trying to break to our right about 44 miles to your north west" and soon thereafter " passing through, we saw a big fireball in the cloud and I saw fire debris; Two distinct

fires on the ground". Soon the Radar Controller at Delhi ATC realised that a mid-air collision had taken place.

1.5 According to the villagers who happened to witness the collision, "there was at first an earth shattering sound which shook the entire village. The doors and windows of the houses were shattered and glass panes were strewn all around. Frightened families, believing it to be an earthquake, came out of their houses. A huge ball of fire had engulfed the sky and then the two planes fell off in different directions to turn into debris and burnt dead bodies, all scattered in an area of a few kilometers in the fields".

1.6 The officials of Civil Aviation Department, the local administration and the police, all swung into action. BBC and CNN were the first to flash the `stop -telecast'news. There was panic all around. Heart-rending scenes were witnessed as friends and relatives, who had seen off the passengers of the ill-fated Saudi aircraft just a couple of hours earlier, started making frantic enquiries. At the site approximately 20,000 people had gathered which

hampered rescue operations and gave police a tough time.

1.7 The DGCA took cognizance of the accident and immediately appointed Capt KPS Nair, Dy Director, Flight Crew Standards, to act as Inspector of Accident, to carry out investigation under Rule 71 of the Aircraft Rules, 1937.

1.8 Such was the gravity of the calamity that the Union Cabinet met under the Chairmanship of the then Prime Minister Shri HD Deve Gowda to take stock of the situation. The Hon'ble Prime Minister of India, accompanied by Shri Bansi Lal, the Chief Minister of Haryana, visited the site of the accident. The Prime Minister announced holding of a judicial inquiry by a sitting High Court Judge.

1.9 The whole world was shocked and the nation was stunned at such a colossal loss of human life and property besides destruction of the two aircraft.

1.10 On the morning of 14.11.96 Shri H.S. Khola, the Director General of Civil Aviation, contacted me and sought an appointment to hold a briefing about

the progress of the investigation carried out by the Inspector of Accident. Shri Khola accompanied by Shri Satender Singh, Dy DGCA, Capt. KPS Nair and Shri V.K.Arora, Controller of Airworthiness (appointed as Secretary to the Court of Inquiry) met me in my chambers in Delhi High Court and briefed me on the progress of investigation carried out till then. It was reported that the Inspector of Accident was carrying out the investigation and ensuring that the necessary factual information and evidence were gathered at the earliest and measures were taken to see that no evidence was lost prior to taking over of the inquiry by the Court. The DGCA officers and Inspector of Accident were advised to continue with the investigation and to keep the Court informed of the progress made from time to time and to comply with the directions issued by the Court.

1.11 On 15.11.1996 the Central Government issued notification announcing formal investigation and constitution of the Court of Inquiry under Rule 75 of Aircraft Rules,1937.

1.12 On 16.11.1996, I, accompanied by Air Cmde (Retd) T.

Pannu, Ex-Director Operations (ATC), IAF (appointed as assessor), Shri Khola DGCA, Capt Nair, Inspector of Accident, Shri Satender Singh, Dy DGCA and Shri V.K.Arora, Secretary to the Court, went by surface transport to Charkhi Dadri. Shri GB Kumar, Commissioner Hissar, Shri Sheokand, Distt. Commissioner Bhiwani and Shri A. Akil, Supdt of Police, Bhiwani also joined the members of the Court.

1.13 The wreckage of the aircraft was lying in two different areas : one, near Charkhi Dadri within the jurisdiction of Bhiwani District, and the other, within the limits of Rohtak District. The Court first visited the wreckage site near Charkhi Dadri. Most of the wreckage of the Saudi aircraft was lying in this area. The District authorities informed the Court about the post accident action taken by them and also about the disposal of the dead bodies. The District authorities desired to know future plans about securing the wreckage. The Court instructed that since the wreckage examination was in progress and not yet completed, it should be protected in "as is where is" condition and necessary help should be given to the

Inspector of Accident and his team in the examination of the wreckage and retrieval of the parts for investigation. The Court gave instructions to the local authorities and the Director of Air Safety to dig the area where the nose of the Saudi aircraft had impacted to retrieve the cockpit instruments, particularly the altimeters. In the afternoon the Court visited the other site of wreckage in Rohtak District. The District Commissioner, Rohtak, Mr.Prasad, and other district officials also joined the Court during the inspection. At this site most of the wreckage of the Kazak aircraft was lying. This wreckage, particularly the front portion of the IL-76 aircraft, was in a fairly intact condition. Shri V.K. Chandana, the Director of Air Safety, DGCA, along with his team and representatives of Kazak Airlines, was working at the site. They had retrieved four altimeters from the wreckage of the Kazak aircraft. The Court inspected the articles. Readings of the altimeters and their physical condition were noted and photographed. Wreckage pattern was inspected. Rohtak District authorities were also instructed to preserve the wreckage in "as is where is" condition till the examination was

concluded.

1.14 It appears that the local police had registered an offence under Sections 304 A, 337,279 of Indian Penal Code in respect of the accident. On a request made on behalf of the Embassy of Republic of Kazakhstan and Rohtak District Administration, the Court issued on the spot a "no objection" to personal belongings of the passengers of Kazak aircraft IL-76 (seized by the police) being released. However, the passports, licences, flight identity cards, currency declaration books and other documents which accompany the crew on board the aircraft, were directed not to be released as the same might be required for investigation purposes.

1.15 On 18.11.1996, on behalf of the Court, the assessor Air Cmde T. Pannu visited the site so as to take `on the spot' stock of the investigation in progress and to issue suitable instructions, if necessary.

1.16 On information being received that the cockpit of the Saudi Arabian aircraft had been dug out, the

Court accompanied by the Assessors Air Cmde T. Pannu and Capt. A.K. Verma as also the Inspector of Accident visited the site of the accident on 25.11.1996. Shri V.K.Chandana and Shri A. Akil, Capt Mohd IA Khan, representative of Saudi Government, and an Engineering representative of the Saudi Arabian Airlines were present at the site. Capt Ommar S. Barayyan from Presidency of Civil Aviation, Saudi Arabia and Shri B.U. Salimov, Acting DGCA Kazakhstan, respectively designated as the Accredited Representatives of the two States were also present at the site.

1.17 The cockpit of Saudi aircraft was completely smashed. On account of impact of the crash the instruments in the cockpit had been badly crushed. They had also been destroyed by fire. No instrument or part of cockpit was in a shape so as to be of any use in the investigation. Nothing could be identified as the altimeters belonging to the Saudi aircraft.

1.18 The Court and the Assessors inspected the main portion of the wreckage of Saudi aircraft and the crater which was dug to retrieve cockpit

instruments etc. After consulting the Accredited Representatives, the SP Bhiwani and the Director of Air Safety, it was concluded that further search for recovering the Saudi altimeters and cockpit instruments was not likely to yield any result. As such, further search in that direction was directed to be called off. The Court also visited the wreckage site of Kazak aircraft in Rohtak District and took stock of the security arrangements.

1.19 All the wreckage was being adequately guarded by the police and local administration. Main sites were cordoned off. Though the local authorities at both the sites were requesting for disposal of wreckage, they were advised to wait till further directions.

1.20 Fortunately, the black boxes of both the ill-fated aircraft were retrieved from the site of the accident. Cockpit Voice Recorder and Digital Flight Data Recorder of Saudi aircraft as also the Cockpit Voice Recorder and Flight Data Recorder of Kazak aircraft had been found. They were apparently intact and undamaged except for some superficial scratches on the casings. They were

inspected by the members of the Court at the site.

1.21 The two sets of black boxes and the four altimeters of Kazak aircraft were sealed and consigned to safe custody of Inspector of Accident.

CHAPTER - II

Factual Information

CHAPTER II

FACTUAL INFORMATION

2.1 History of Kazak Flight KZ-1907

2.1.1 Kazakhstan IL-76 aircraft departed from Chimkent (Kazakhstan) on 12.11.1996 at 10:25 UTC operating Flight Kazak 1907 to Delhi Airport with 37 persons including 10 crew members on board. The aircraft IL-76 was owned by SHYMKENT AVIA of Kazakhstan and was on a non-scheduled flight carrying tourists from Kazakhstan to India.

2.1.2 The IL-76 aircraft was under the command of Capt. Alexander Robertovich Cherepanov along with Co-Pilot, Flight Engineer, Flight Navigator and Radio Operator as flight crew members.

2.1.3 A flight plan was filed at Chimkent before departure and the same was received by the Air Traffic Services of IGI Airport, Delhi before Kazak-1907 came in contact on VHF. The flight plan indicated Estimated Time of Departure (ETD) CHIMKENT 1030 hours, flight level 330, entry India

at `Tiger' on route G-452 and flying time to Delhi as 3 hours 10 minutes. The flight, with alternate aerodromes as Bombay and Ahmedabad, had uplifted 62 tonnes of fuel at Chimkent.

2.1.4 Kazak 1907 initially came in contact with Delhi Radio (HF) at 1100 hours when it reported maintaining flight level 330 and estimated `Tiger' at 1243 hours and gave Estimated Time of Arrival (ETA) Delhi as 1323 hours.

2.1.5. The aircraft contacted Delhi Control on Very High Frequency (VHF) 124.55 MHz at 1253 hours, maintaining flight level 330 at position LUNKA. LUNKA is a reporting point on radial 270 from Delhi on international route G-452 and is 177 miles west of Delhi. Subsequently at 1254 hours, the aircraft reported at 168 miles DME from Delhi VOR.

2.1.6 The aircraft was initially cleared by Area Control (West) of Delhi ATC to descend to flight level 250 at 1258 hours and subsequently, at 1303, it was cleared to descend to flight level 180 and was asked to report passing flight level 200. While passing flight level 240, at 1305 hours, the aircraft was asked to change over to Delhi Approach on frequency 127.9 MHz.

2.1.7 At 1305 hours, KZ-1907 contacted Delhi Approach and

reported passing flight level 230 at 74 miles from Delhi VOR. Delhi Approach further cleared the aircraft to descend to flight level 150 with the instructions to report reaching level 150. At 1310 hours, in reply to a query from Approach, Kazak 1907 reported reaching flight level 150 on radial 270. At this time, the aircraft was identified by Radar and advised to maintain Flight Level 150. Traffic information on reciprocal Saudi B-747 aircraft "12 O'Clock at 10 miles likely to cross in another 5 miles" was also passed at this time. Kazak 1907 acknowledged the same and asked for the distance of the traffic again. To this, Approach replied "traffic is at 8 miles now FL 140." Kazak 1907 acknowledged the distance information of traffic at 8 miles and said that they were looking for the traffic. This was the last transmission from Kazak IL-76 aircraft to Delhi ATC.

2.2 **History of Saudi Flight SV-763**

2.2.1 Saudi Airlines B-747 aircraft, callsign SV-763 departed from Delhi for Dhahran at 1303 hrs. with 312 persons on board including 23 crew members. The aircraft was owned by Saudi Arabian Airlines. It had arrived earlier from Jeddah and this was a return flight from Delhi for Saudi Arabia.

2.2.2 The flight plan of SV-763 flight filed with Delhi ATC gave Estimated Time of Departure Delhi as 1245 hours, flight level 350 on route G-452 to Dhahran with B-747 aircraft under the command of Capt. Shubaily.

2.2.3 The aircraft departed at 1303 hours from Runway 28 of Delhi airport. It was cleared to Dhahran via G-452, Flight Level 350, Departure PARVI-1, initially Flight Level 260, request level change enroute.

2.2.4 After airborne, Saudi SV-763 contacted Delhi Approach on frequency 127.9 MHz. Delhi Approach indentified SV-763 on Radar and cleared the aircraft to climb to flight level 100 initially and advised it to standby for higher level. Subsequently at 13:07 hours, SV-763 reported approaching flight level 100 and Approach Radar cleared the aircraft to climb to flight level 140. At 1309 hours, SV-763 reported approaching flight level 140 and requested for higher level. In reply to this, Approach Radar instructed SV-763 to maintain flight level 140 and standby for higher. SV-763 acknowledged the same transmitting "Saudi 763 (will) maintain one four zero."

2.2.5 Saudi SV-763 was following G-452 route which is on radial 270 from Delhi VOR and as such was reciprocal to the arriving Kazak-1907 flight. At 1311 hours the following transmission in Arabic language was found recorded on the ATC tape. "Astaghfor Allah, Ashhau Unlealaha Ella Allah". According to the Saudi Representatives, this transmission was from their aircraft and the English translation of the same is "God Forgiveness, I witness no other God but Allah". Thereafter, there was no transmission from Saudi Aircraft.

2.2.6 Meanwhile, the Approach Controller lost radar contact with SV-763 and Kazak-1907. At 1312 hours, a U.S. Air Force aircraft, Call Sign M-1815, on flight from Islamabad to Delhi via Hissar, reported to Delhi Approach, sighting a big fireball followed by two distinct fires on the ground. This aircraft was estimating to arrive Delhi at 1320 hours, on route Amber 466 and was flying north of route G-452. The U.S. Air Force aircraft, at that time was flying approximately 15 miles North of the point where the radar blips of Saudi SV-763 and Kazak-1907 disappeared from the radar screen. The aircraft reported to the Approach Controller, "We saw something to our right

looks like a big fire ball.....looks like a big explosion". Immediately upon receipt of this information from the U.S. Air Force aircraft, the Approach Controller gave repeated calls to the Kazak aircraft and also to Saudi aircraft but there was no response. The US aircraft further reported at 1313 hours "we see two fires trying to break to our right about four four miles to your North-West at this time". On a query from Approach Control, the aircraft further replied, "passing through, we saw a big fire ball in the cloud and I saw fire debris. Two distinct fires on the ground, over". The Controller apprised the Watch Supervisory Officer of the above and consequently rescue action was initiated.

Subsequently, it was confirmed through ground reports from the district authorities of Bhiwani and Rohtak (Haryana) that the wreckage of both the aircraft had been sighted and was spread out in an area of 5-6 kms. Further it was confirmed that both the aircraft had been destroyed due to fire and impact. It was also reported that, perhaps, there were no survivors from either of the flights.

2.2.7 The wreckage of the Saudi B-747 aircraft fell near village Dhani-Phogat in Bhiwani Distt. of Haryana and

was on fire even when the villagers and rescue team of the civil authorities and Airports Authority reached the site. Bodies were spread around in the fields and also trapped in the debris which were extricated by the local authorities.

2.3 Injuries to Persons

KZ-1907

Injuries	Crew	Passengers	Others
Fatal	10	27	-
Serious	-	-	-
Minor/None	-	-	-

SV-763

Fatal	23	289	-
Serious	-	-	-
Minor/None	-	-	-

2.4 Damage to Aircraft

Both the aircraft were destroyed due to impact and fire.

2.5 Other Damages

Standing crops between villages Birohar and Kachhrauli in Rohtak district where Kazak aircraft wreckage fell and between Dhani Phogat and Patuwas in Bhiwani district where Saudi aircraft wreckage

fell were damaged due to fire, impact and rescue operations.

2.6 Personnel Information

2.6.1 Kazak-1907 Crew

A. Commander of the Aircraft

1.Name	: Capt. Alexander Robertovich Cherepanov
2.Year of Birth	: 1952
3.Technical Qualification	: Civil Aviation Ist Class Pilot
4.Educational Qualification	: Higher, Civil Aviation Academy, 1987
5.Total flying experience	: 9229 hours, including 1491 hours at night.
6.Flight time on IL-76	: 1488 hours including 733 hours at night.

7.PIC experience on IL-76: 1287 hours

8.Flight time on International Routes	: 708 hours 40 minutes
9.Date of last check on IL-76	: 26-27 August, 1996

B. Second Pilot

1. Name	: Ermek Kozhahmetovich Dzhangirov

2. Year of Birth	:	1959
3. Technical Qualification	:	Civil Aviation 2nd Class Pilot.
4. Educational Qualification	:	Higher, Civil Aviation Academy
5. Total flying time	:	6822 hours 45 minutes
6. Flight time on IL-76	:	409 hours 35 minutes including 215 hours 25 minutes at night
7. Flight time on International Routes	:	207 hours 50 minutes routes.
8. Last check of piloting techniques.	:	22-23 March, 1996
9. Check on aircraft driving.	:	21-23 December, 1995

C. **Navigator**

1. Name	:	Zhahanbek Duisenovich Aripbaev
2. Year of Birth	:	1945
3. Technical Qualifications	:	Civil Aviation 1st Class Navigator.
4. Educational Qualification	:	Higher, Ulianovsk' Higher Civil Aviation Flight College, 1992
5. Total flying time	:	12789 hours including 3835 hours at night
6. Flight time on IL-76	:	1327 hours including 539 hours at night
7. Flight time on International Routes	:	581 hours

8.	Check on aircraft driving	: 10-11 March, 1996.

D. **Flight Engineer**

1.	Name	: Alexander Alexanderovich Chuprov
2.	Year of Birth	: 1946
3.	Technical Qualification.	: Civil Aviation 1st Class Flight Engineer
4.	Educational Qualification	: Higher, Kiev' Civil Aviation Engineers Institute 1978
5.	Total flight time	: 9201 hours
6.	Flight time on IL-76	: 1248 hours
7.	Flight time on International Routes	: 1178 hours
8.	Last Check	: 2-4 December, 1995

E. **Radio Operator**

1.	Name	: Egor Alekseevich Repp
2.	Year of Birth	: 1955
3.	Technical Qualification.	: Civil Aviation 2nd Class Radio Operator
4.	Educational Qualification	: Secondary, Kremenchug' Civil Aviation Flight College, 1975 Flight Operators course of Ulianovsk' Trg. and Technical centre
5.	Total flight time as Radio Operator on IL-76	: 1583 hours

6. Flight time on international Routes : 645 hours

7. Last Check : 20-21 August, 1996

2.6.2 Saudi SV-763 Crew

A. Commander of the Aircraft

1. Name : Khalid Al-Shubaily

2. Date of Birth : 9.9.1951

3. Nationality : Saudi Arabia

4. Qualification : Captain B-747

5. Licence Details : FAA ALTP No. 2228987
PCA TA-0781 (Saudi)

6. Endorsements on Licence : ATP multi-engine land. A-310, B-737, B-747,L-1011.

7. Total Flying Experience: 9837 Hrs.

8. Flight Time :

a) By Day : N/A
b) By Night : N/A

9. Total PIC Experience : 4313 Hrs.

10. Pilot-in-Command Experience on B-747-100: 104 Hrs.

a) By Day : N/A
b) By Night : N/A
c) During last 30 days: 56:36 Hrs. (Excluding the accident flight)

11. Flying Experience on International Routes : N/A

12. Date of last proficiency check on B-747-100

a) On Aircraft : 1.9.1996
b) On Simulator : 29.6.1996

13. Date of Last Licence Renewal Medical and Validity. : 15.5.1996

valid until the end of Nov., 1996 (Calender month)

B. **Second Pilot**

1. Name : Capt. Nazir Khan

2. Date of Birth : 15.12.1958

3. Nationality : USA

4. Qualification : First Officer B-747

5. Licence Details : FAA ALTP No. 2328121
PCA TA 2872 dated 9.2.1993 (Saudi)

6. Endorsements on Licence. : ATP multi-engine land.
B-707, B-720

7. Total Flying Experience : 7779 Hrs.

8. Flying Experience on B-747-100 : 1952 Hrs.

a) By Day : N/A
b) By Night : N/A
c) During last 30 days (Excluding the accident flight) : 63:53 Hrs.

9. Flying Experience on International Routes : N/A

10. Date of last proficiency check on B-747-100

a) On Aircraft : 13.10.1996
b) On Simulator : 19.10.1996

11. Date of Last Licence Renewal Medical and Validity. : 9.10.1996

Valid until the end of Oct.,1997

C. Flight Engineer

1. Name : Mr. Ahmed S. Edrees

2. Date of Birth : 1.1.1963

3. Nationality : Saudi Arabian

4. Qualification : Flight EngineerB-747

5. Licence Details : FAA Licence No.2417631

Saudi Licence No. FE 1045 dated 6.11.1989

6. Total Flying Experience : 3326 Hrs.

7. Flying Experience on B-747-100 : 1755 Hrs.

8. Flying Experience on: International Routes N/A

9. Date of last proficiency check on B-747-100

a) On Aircraft : 8.7.1996
b) On Simulator : 3.11.1996

10. Date of Last Licence Renewal Medical and Validity. : 25.12.1995

Valid until the end of Dec., 1996

2.7 Flight Duty Time

As per the Saudi Airlines, all the crew personnel had more than 70 hours rest prior to the departure of the accident flight for Delhi. Kazak Airlines however have not furnished information in this regard.

2.8 Pre-Flight Medical

According to Saudi, there is no system of pre-flight medical prior to every departure. Kazak Airlines have not forwarded their information in this regard.

2.9 Aircraft Information

2.9.1 Kazak IL-76 Aircraft

Aircraft Details

1.	Series	: 8607
2.	Factory No.	: 1023413428
3.	Date of Production	: 31.7.1992
4.	Producer	: Tashkent' Aviation Production Association, Republic of Uzbekistan
5.	Airworthiness of aircraft for civil flights	: KA-1113 of 1.9.1992
6.	Period of validity of the airworthiness of aircraft for civil flights.	: Till 31.7.1997
7.	Certificate of aircraft registration	:No.0248 of 15.6.1994
8.	Total flown time as on 11.11.1996	: 2643 hours 39 mins.

2.9.2 **Details of altimeters fitted to IL-76 Kazak-1907 flight**

(As provided in the records submitted by Kazak Airlines)

1. Number of Altimeters Installed

A.	VMF	-	50 KG (CAPT)	4 Nos.
B.	VMF	-	50 KG (NAV)	
C.	UV	-	75-15-PV (CAPT)	
D.	UV	-	75-15-PV (CO-PILOT)	

2. Make of Altimeter

PSO 'LUH' CITY - ULYNOVSK

3. Type of Altimeter (Pneumatic/Electrical etc.)

A. PNEUMATIC
B. PNEUMATIC
C. ELECTRICAL
D. ELECTRICAL

4. Serial No. of Altimeters

A. 0508040
B. 0613061
C. 0513159
D. 0513164

5. Mode of Indication (Digital/Analog)

A. ANALOG
B. ANALOG
C. DIGITAL & ANALOG
D. DIGITAL & ANALOG

6. Units of Altitude Indication

A. FEET
B. FEET
C. METERS
D. METERS

7. Altimeter Setting Unit (Hecta Pascal/Millimeters/Inches)

A. HECTA PASCAL
B. HECTA PASCAL

C. MILLIMETERS
D. MILLIMETERS

8. Past History

a. When Installed on Aircraft

A. 10.8.1992
B. 10.8.1992
C. 9.8.1992
D. 9.8.1992

b. Date of Last Shop Test

A. 10.4.1995
B. 10.4.1995
C. 11.4.1995
D. 12.4.1995

c. Snags within preceding 3 months

A. Nil
B. Nil
C. Nil
D. Nil

2.9.3 Saudi B-747 Aircraft

A. Aircraft Details

1.	Manufacturer	:	Boeing Aircraft Co.,USA
2.	Type	:	B-747-168B
3.	Registration	:	HZ-AIH
4.	Serial No.	:	22748
5.	Year of Manufacture	:	1982
6.	Certificate of Airworthiness	:	Issued on 1.7.1996 by Ministry of Defence & Aviation, Presidency of Civil Aviation, Kingdom of Saudi Arabia.

7.	Category	:	Standard Transport
8.	Certificate of Registration	:	Issued by Ministry of Defence and Aviation. Presidency of Civil Aviation, Kingdom of Saudi Arabia.
9.	Minimum Crew Required:		Three flight Crew Members Captain. First Officer and Flight Engineer.
10.	Maximum authorised all-up-weight	:	340194 Kgs.
11.	Total hours/cycles done	:	40035 hours/14927 cycles.
12.	Last Major Inspection Done	:	Overhaul 'D' Check carried out in March 1993.
13.	Last Minor Inspection Done	:	In-service Check on 12.11.1996.
14.	Details of Flight Release	:	At Delhi before departure on 12.11.1996, walk around check. Found tail navigation light inoperative. Removed and replaced. Tail navigation bulb operation check and found OK. Engine Oil added # 1-3 Qt # 2-6QT # 3-2Qt # 4-6 Qt.
15.	Items under Minimum Equipment LIst, if any	:	Nil
16.	Details of Last Pre-flight Inspection done	:	Pre-departure Inspection conducted by certified machanic # BO-065 on 12.11.1996 at 12:10 UTC.

		Part No.	Sl. No.
17.	Details of Altimeters indicating location : with Serial No. and unit of calibration		
	Servo Altimeter #1	2051-031	132
	Servo Altimeter #2	2051-031	104
	Standby Altimeter	64141-570-1	768
	(Units of calibration in feet)		
18.	Details of Incidents/ Major Snags during the preceding six months. :	Information N/A.	
19.	Seating Configuration & Capacity :	387 seats including 18 First class and 369 Guest Class	

B. Engine Details

1. Manufacturer : Rolls Royce

2. Type : RB211-524C2-19

Engine No. 1

1. Serial Number : 12299

2. Hours Done

a)Since New : 21087 Hours
b)Since Last Overhaul : 1374 Hours

3. Details of Incidents/: Major Snags during the preceding six months. Information N/A.

Engine No. 2

1. Serial Number : 12250

2. Hours Done

a)Since New : 29862 Hours
b)Since Last Overhaul: 2398 Hours

3. Details of Incidents/ Major Snags during the preceding six months : Information N.A.

Engine No. 3

1. Serial Number : 12249

2. Hours Done

a)Since New : 32465 Hours
b)Since Last Overhaul: 2965 Hours

3. Details of Incidents/ Major Snags during the preceding six months : Information N/A.

Engine No. 4

1. Serial Number : 12257

2. Hours Done

a)Since New : 29200 Hours
b)Since Last Overhaul: 2379 Hours

3. Details of Incidents/ Major Snags during the preceding six months : Information N.A.

2.9.4 Details of Altimeters on Boeing-747 Aircraft

1. Number of altimeters installed :

A. Servo Altimeters : 2
B. Standby Altimeter : 1

2. Make of Altimeters

A. Servo Altimeters : HAROWA/SMITH
B. Standby Altimeter : JADGER

3. Type of Altimeters

A.	Servo Altimeters	:	Electrical type
B.	Standby Altimeter	:	Pneumatic type

4. Serial Number of Altimeters

A.Servo Altimeter (Captain):		Mfr.Sl. No.132
Servo Altimeter (Co-pilot):		Mfr. Sl.No.104
B.Standby Altimeter	:	Mfr. Sl.No.768

5. Mode of Indication

A.	Servo Altimeter	:	Analogue
B.	Standby Altimeter	:	Analogue

6. Units of Altitude Indication

A.	Servo Altimeters	:	Feet (-1000 to +50000 ft.)
B.	Standby Altimeter	:	Feet (-1000 to +50000 ft.)

7. Altimeter Setting Unit

A.	Servo altimeters	:	Inches of Mercury/ Millibars (22.0" of Mercury/740 Mb to 31" of Mercury/1050 Millibars)
B.	Standby Altimeter	:	Inches of Mercury (28.1" of Mercury to 31.0" of Mercury)

8. Past History

a) When installed in aircraft

A.Servo Altimeter(Capt)	:	26.3.1994
Servo Altimeter(Co-pilot:		29.11.1992
B.Standby Altimeter	:	31.8.1995

b) Date of last shop test :

A.Servo Altimeter No. 1 (Capt):		March, 1994
Servo Altimeter No. 2	:	March, 1992

(co-pilot)

B.Standby Altimeter : August, 1995

c) Snags within the preceding three months. : Nil

2.10 Meteorological Information

The meteorological service throughout civil airports in India is provided by India Meteorological Deptt. This department has offices at all major airports which provide weather forecasting and current weather reports. The Delhi airport has Met. watch office serving 24 hours and provides all the meteorological information and forecast required for flight operations.

The Met. report and Speci issued from time to time are also broadcasted on VHF frequency 126.4 MHz on a continuous basis. The responsibility of updating this information is with the Duty Officer (ATIS) of Airports Authority of India (National Airports Division) located at the Control Tower.

Following are the Met. reports of Delhi airport as issued by Met Watch Office at Palam Airport for the period immediately preceding the accident.

Special Met Report 121230 UTC

Surface Wind	-	Calm
Visibility	-	3000 meters
Clouds	-	SCT (Scattered), 10,000 feet (3000 meters)
Temperature	-	25 degree C
Dew Point	-	08 degree C
QNH	-	1011 HPa (29.86 inches)
QFE	-	984 HPa (29.07 inches)
Trend	-	No Sig.

Dated 12.11.1996 - Time : 1231

Met. Report VIDP 121300 UTC

Surface Wind	-	Calm
Visibility	-	2200 meters
Present Weather	-	FU (smoke)
Clouds	-	SCT (Scattered), 10,000 feet (3000 meters)
Temperature	-	24 degree C
Dew Point	-	08 degree C
QNH	-	1011 HPa (29.86 inches)
QFE	-	984 HPa (29.07 inches)
Trend	-	No Sig.

Dated 12.11.1996 Time : 1301

Special Met. Report VIDP 121330 UTC

Surface Wind	-	Calm
Visibility	-	1800 meters
Rwy 28 RVR Rwy 10 RVR	-	Above 2000 meters
Mid RVR Rwy 27 RVR	-	Above 2000 meters
Present Weather	-	FU (smoke)
Clouds	-	SCT (Scattered), 10,000 feet (3000 meters)

Temperature	-	24 degree C
Dew Point	-	08 degree C
QNH	-	1011 HPa (29.86 inches)
QFE	-	984 HPa (29.07 inches)
Trend	-	Becoming visibility 1500 meters
Dated 12.11.1996		Time : 1331

The ATIS on 126.4 MHz had broadcast the Special Met. report of 121230 and Met. Report of 121300.

2.11 **Aids to Navigation**

Delhi Airport is equipped with following navigational aids :

Facility	Frequency	Call Sign	Power/ Output	Status on 12.11.96.
Doppler VOR	116.1 MHz	DPN	100W	Serviceable
DME (co-located with VOR)	1132 MHz 1195 MHz	DPN	1000W	Serviceable
NDB (DP)	274 KHz	DP	100W	Serviceable
NDB (DH)	329 KHz	DH	80W	Serviceable
ASR	Primary Radar with 60 NMs range.			Serviceable

2.12 **Communication**

Delhi airport is equipped with HF and VHF communication on different frequencies. There is no evidence of any breakdown of R/T communication between the Delhi ATC and both the aircraft at any stage of their flights.

2.13 **Aerodrome Information**

Coordinates :

Latitude	:	28 Degrees 34'07" North
Longitude	:	77 Degrees 06'48" East
Elevation	:	227 mtrs (744 feet) AMSL
Runway Designation	:	28/10 27/09

Main Instrument Runway is 28.

Terminals

The International terminal is on the southern side of the airfield whereas the domestic terminal is located at the northern side of the aerodrome.

Taxiways

Taxiways are designated as A, B, C, D, E, G, L, M, N, P, Q and R. The aircraft from international terminal taxi out from the terminal to Runway 28 for departure via taxiway R1, R, L1, P and G to taxi holding Runway 28.

2.14 Air Traffic Control (ATC)

The Air Traffic Control (ATC) tower is located at the domestic terminal. The aerodrome control is located at the top of the control tower which has a height of 39.24 meters above ground. The building houses other ATS units like Area Control (West and East), Approach Control Office, Approach Radar Display, Communication Equipment Room, ATS Briefing, Meteorological Briefing Office, etc.

There are three main ATC Units :

i. Aerodrome Control (TWR)
ii. Approach Control (APP)
iii. Area Control (ACC)

2.14.1 Aerodrome Control

The aerodrome control is located in the glass room on top of the control tower building with unobstructed viewing facility of the entire aerodrome in good visibility conditions. The aerodrome control has three duty officers at a time.

i. Duty Officer SMC.
ii. Duty Officer Aerodrome Control.
iii. Duty Officer ATIS.

The Duty Officers are rated Controllers and control the traffic in the vicinity of the aerodrome. Aerodrome Control communicates with aircraft on frequency 118.1 MHz. The Surface Movement Control operates on frequency 121.9 MHz.

The Duty Officer Aerodrome Terminal Information Service (ATIS) is responsible for the broadcast of Aeronautical Terminal Information Service provided on VHF 126.4 MHz located at the Control Tower.

The aerodrome controller is also required to coordinate with approach controller on intercom provided between them.

The departing aircraft is issued with ATC clearance before take-off, by aerodrome control, after coordination with the Approach Control/Area Control. Before take-off, the departure clearance is also issued by the Aerodrome Control after coordination with approach controller for separating traffic in its area of responsibility.

The aerodrome controller hands over the departing aircraft after it is airborne to approach control and clear of traffic within its jurisdiction.

The aerodrome controller takes over the control of arriving aircraft within its vicinity in visual meteorological conditions or as coordinated with approach control/radar during the course of instrument approach to land in IMC.

The aerodrome control tower also houses a qualified Met. observer who, with the help of the instruments provided in the tower, gives the current weather observations.

2.14.2 **Approach Control**

The approach control in Delhi airport handles arriving and departing traffic. The upper limit of approach control services is Flight Level 190. The approach controller makes use of approach radar which has a range of about 60 nautical miles.

The approach control operates on Very High Frequency 127.9 MHz. However, when surveillance radar approach is provided, radar functions on frequency 119.3 MHz.

The approach control office is located on the 3rd floor of the control tower building. The office of the ATC Watch Supervisory Officer (WSO) is also located at the same location.

2.14.3 **Area Control Centre (ACC)**

The ACC provides separation between aircraft within the terminal control area of Delhi. For effective functioning, the responsibility is divided between two controllers that is Area-West and Area-East. All traffic within the TMA of Delhi outside the jurisdiction of Approach Control is with ACC West/ACC East. Delhi ACC West operates on VHF 124.55 MHz and ACC East operates on VHF 120.9 MHz.

2.14.4 **Jurisdiction of ATS Units**

Airspace	Unit Providing Service	Radio Call Sign
UL FL 190) LL FL 65)	Delhi Approach	Delhi Approach
UL FL 460) LL FL 200)	ACC Delhi	Delhi Control

2.15 **Altimeter Setting Procedures in Indian Airspace**

The Aeronautical Information Publication (AIP) lays down the altimeter setting procedure for aircraft flying in the air space. Accordingly,

(a) Transition altitude is specified for each aerodrome and no transition altitude is less than 4000 feet.

(b) Vertical positioning of aircraft when at or below transition altitude is expressed in terms of altitude whereas such positioning at or above the transition level is expressed in terms of flight levels. While passing through the transition layer, vertical positioning is expressed in terms of altitude when descending and in terms of flight level when ascending.

(c) Flight level `zero' is located at the atmospheric pressure level of 1013.2 HPa (29.92 inches). Consecutive flight levels are separated by pressure interval corresponding to 500 feet in standard atmosphere.

(d) For take-off and climb,

(i) the QNH altimeter setting is made available to the aircraft in taxi clearance prior to take-off.

(ii) vertical positioning of aircraft during climb is expressed in terms of altitudes until reaching transition altitude above which vertical positioning is expressed in terms of flight levels.

(e) Vertical separation enroute :

Vertical separation during enroute flight shall be expressed in terms of flight levels at all times. Except when flying in the vicinity of aerodrome at or below transition altitude.

(f) Approach and Landing :

(i) A QNH altimeter setting is made available in the routine approach and landing instructions. The altimeter setting obtained on radio telephone shall be read back to the ATS Unit.

(ii) vertical positioning of the aircraft during approach is controlled by reference to flight levels until reaching the transition level below which vertical positioning is controlled by reference to altitudes".

2.16 **ATC Duty Officers on 12.11.1996**

2.16.1 **Aerodrome Control Tower**

1.	Name	:	Shri Satyajit Dutta
2.	Designation	:	Senior Aerodrome Officer
3.	Ratings Held	:	All procedure ratings (Aerodrome Control, Approach Control and Area Control)

2.16.2 **Approach Controller**

1.	Name	:	Shri V.K. Dutta
2.	Designation	:	Senior Aerodrome Officer
3.	Date of Birth	:	17.1.1954
4.	Educational Qualification	:	B.Sc.
5.	Technical Qualifications	:	ATC Rated for aerodrome control, approach procedure control and approach radar control.
6.	Career Profile	:	

The officer had joined as Aerodrome Operator in 1980 and was selected as Aerodrome Officer in 1985. Subsequently, he underwent Aerodrome Officer's ab-initio course at Allahabad during 1985-86. Posted to Delhi airport and served till 1988. Subsequently during 1988-89 served as Aerodrome Officer at Shimla airport. Posted back to Delhi airport as ATC Officer and continued since 1989. He acquired all procedure ratings of Delhi airport. He underwent radar simulator training

at CATC Allahabad during 1992. Subsequently rated by the board on Delhi Airport Radar during 1993 and 1995 respectively. He had also undergone training on modern facilities at Boston Airport during March-April, 1995.

2.16.3 **ACC (West) Controller**

1.	Name	:	Shri J. Purkayastha
2.	Designation	:	Aerodrome Officer
3.	Ratings Held	:	All procedure ratings (Aerodrome Control, Approach Control and Area Control).

2.16.4 **Watch Supervisory Officer**

1.	Name	:	Shri A.K. Jha
2.	Designation	:	Deputy Director
3.	Educational Qualification	:	Graduate
4.	Technical Qualification.	:	Commercial Pilot's Licence
5.	Ratings Held	:	Aerodrome control, approach control (procedures), approach radar, air route surveillance radar.

2.17 **Flight Recorders**

Saudi Boeing 747 aircraft flight recorders i.e. cockpit voice recorder and digital flight recorders were retrieved from near the wreckage of the tail portion of the aircraft. The outer casing of the DFDR although partially damaged, the recorder crash proof portion appeared to be intact. As regards to the Cockpit Voice Recorder it appeared to be intact except minor damage to its outer casing.

Two Flight Recorders of the Kazak IL-76 aircraft were retrieved from the wreckage at the accident site and were identified by Kazak Airlines engineers as Flight Data Recorder and Cockpit Voice Recorder. The condition

of both the recorders appeared to be intact.

2.18 **Cockpit Voice Recorders**

2.18.1 **Saudi B-747 Aircraft**

Manufacturer	:	Lockheed
Part No.	:	A100
Manufacturer Serial No.	:	15591
Saudi Serial No.	:	44
Time since Last Inspection	:	1911 Hours
Total Service Time	:	21072 Hours

The voice recorder system records and preserves a continuing record of the last 30 minutes of flight crew communication and conversation. The voice recorder system has four separate inputs for simultaneous recording of any communications in the flight compartment on four track magnetic tape. Channel 1 records audio from the flight engioneer's audio selector panel, Channel 2 records audio from the First Officer's audio selector panel and Channel 3 records audio from the Captain's audio selector panel. Channel 4 audio is taken from a microphone pickup in the voice recorder control panel. An erase head in the recorder unit automatically erases previously recorded information prior to recording, then at any instant a 30 minutes length of closed loop magnetic tape provides record of the previous 30 minutes of conversation.

2.18.2 **Kazak IL-76 Aircraft**

The aircraft was fitted with CVR Model MARS-BM. Basic functions of the CVR are :

- Recording of the speech information of :

  Crew members from their working places.
  Aircraft commander.
  Second Pilot.
  Radio Operator.
  Navigator.
  Flight Engineer.
  Flight Operator.

- Recording of the crew negotiations on external communications (radio communication).

- Recording of the time intervals (fixing of time).

The recording is carried out during the whole flight and saves the information during last 25 minutes. The MARS-BM C/R saves the information under the overload more than 10 'g' and temperature more than 1000@C.

2.19 Flight Data Recorders

2.19.1 Saudi B-747 Aircraft

Manufacturer	:	Lockheed/Teledyne
Model No.	:	209
Part No.	:	10077A500 (Teledyne P/N 2228766-2)
Serial No.	:	2887
Saudi T/N	:	RCD1101
Saudi F-Sl. No.	:	94
Date of Installation	:	15.6.1996
Time since Last Repair	:	152 days
Total Time in Service	:	2006 days

The Digital Flight Data Recorder (DFDR) records selected items of flight data obtained during the last 25 hours of operation of the aeroplane. During operation, all data to be recorded is provided to the DFDR on a serial digital data stream. The DFDR records the digital data stream on 6-Track magnetic tape. The DFDR records 56 parameters including the discrete parameters.

2.19.2 Kazak IL-76 Aircraft

The aircraft was fitted with FDR Model MSRP-64-2. Basic functions of the FDR are :

recording of flight data upto 64 channels (depends

on modification).

recording of special single commands upto 49 channels (depends on modification).

recording of time interval.

signals recording of the flight and airport communication and navigation equipment.

The recording is carried out during the whole flight and saves the last 24 hours of a flight. The MSRP-64-2 FDR saves the information under the overload more than 10 'g' and the temperature more than 1000 degree C.

2.20 Decoding of Flight Recorders - Kazak IL-76

The flight recorders of Kazak 1907 were copied by the experts from Inter State Aviation Committee (IAC), Moscow in the presence of the Court and parties on 1.1.97 at Indian Airlines Radio Workshop.

Both the FDR and CVR were opened by using special equipment which were brought by the experts of IAC, Moscow on the request of the Court. After opening the FDR unit, it was noticed that the tape had slipped from its groove, however, there was no damage to the tape or the recording.

After opening the CVR unit, it was observed that there was no damage to the tape or its recording.

The Kazak CVR and FDR were copied by using special equipment brought by the experts from IAC, Moscow at Indian Airlines Radio Workshop. The FDR copying was re-checked by the experts on the subsequent morning to reconfirm that both the sides of the tape had been correctly copied, this was carried out with the approval and in the presence of the Court. Both original and copy of the FDR and CVR tape were retained under official seal by the Inspector of Accident in fire-proof almirah.

2.20.1 IAC, Moscow - Organisation and Facilities -

The Air Transport Accident Investigation Commission is a plenipotentiary body of the Inter-state Aviation Committee (IAC) responsible for carrying out functions delegated to it by the states to the agreement on civil aviation and the use of air space in the area for conducting independent accident investigation and making recommendations to prevent accident recurrence. The commission's chief objective is flight safety improvement on the basis of un-biased and thorough investigation of specific accidents, generalisation and analysis of information on functioning of air transportation system in the states to the agreement. The following states are the signatory to the agreement :

Azerbaijan
Armenia
Byeloruss
Georgia
Kazakhstan
Kirgizstan
Maldova
Russian Federation
Tajikistan
Turkmenia
Uzbekistan
Ukraine

The institution has the facility to decode DFDRs of aircraft of the Russian Federation including decoding of CVRs. They have requisite equipment for copying of CVP and DFDR, decoding of DFDRs and expert manpower for analysing the data. DFDR data are computer programmed for preparation and analysis. The institution has the facility for taking out graphical printout and also computer data print outs.

As regards to CVR, they have well equipped laboratory with trained and specialised manpower to prepare the transcript and also to analyse speech.

2.20.2 <u>Kazak IL-76 Aircraft</u>

The original CVR and FDR tapes of the Kazak IL-76 aircraft were decoded at the IAC, Moscow facility by their experts on 13th, 14th and 15th Feb., 1997.

2.21 AAIB Facilities - Organisation and Facilities-

Air Accident Investigation Branch (AAIB) of UK is the accident investigation agency of United Kingdom and is part of the Department of Transport of UK. Its main job is to investigate all aircraft accidents which occur in UK and to participate and oversee investigation of British registered or manufactured aircraft when involved. It also provides assistance to foreign countries for accident investigation and also investigates accidents of the military aircraft in UK as and when requested.

In addition, AAIB receives requests for assistance from foreign countries either to loan expert advisors or to replay and analyse flight data recorders and cockpit voice recorders. In order to accomplish this task AAIB has a well equipped FDR laboratory with necessary backup facility and also CVR read out facility with backup facilities like spectrum analyser etc. They have trained and qualified experts to conduct specialised task of opening of the DFDR and CVR including copying, decoding and analysing the data. The institution has the facility of preparing computer print outs of FDR data including graphical presentation of the required parameters. These experts also have the necessary experience in analysing the data of both FDR and CVR.

The institution has additional facility of computer simulation after obtaining the data from the FDR and synchronising with the CVR and ATC tape transcript.

2.21.1 CVR Decoding - Boeing 747

The CVR unit of Saudi B-747 was opened by the experts of AAIB, Farnborough on 17th Feb., 1996 in the presence of the Court and parties. Although the outer casing was damaged due to impact, the CVR tape was intact. Initially CVR tape copy was prepared and all the representatives heard the audio. Subsequently, CVR tape transcript and audio cassettes were also prepared. The entire proceeding of opening the CVR was photographed by the AAIB facility and the copies of the photographs were also handed over.

2.21.2 **DFDR Decoding -Boeing - 747**

After opening the DFDR outer casing, it was revealed that the tape disk was not properly moving on its base. As such the tape was manually transferred to a new spool before making the tape copy. The data recording was undamaged except certain last portion of about two seconds at or about the collision could not be recovered.

2.22 **ATC Tape Transcript**

The relevant ATC tape transcript containing communications between SV-763 on VHF 121.9 MHz with Surface Movement Control and 118.1 MHz with Aerodrome Control and 127.9 MHz with Approach Control/Radar, and the communication between KZ-1907 and Delhi Area (West) on 124.55 MHz and with Approach Control/Radar on 127.9 MHz was prepared. The tape transcript of inter-communiaction between Aerodrome Control to Approach Control and Approach Control to Area Control was also prepared.

2.23 **Wreckage and Impact Information**

Detailed wreckage evaluation was carried out by Shri V.K. Chandna, Director Air Safety and he has submitted a report on the same. From this report, the following salient information has been derived :

2.23.1 **Crash Site Location**

The wreckage of both the ill-fated aircraft were found spread in a trail of about 7 kms. and in a width of about 2 kms, 40 nautical miles West of IGI Airport, New Delhi. The wreckage of Saudi aircraft was close to the Dhani Phogat village (near Charkhi Dadri in Bhiwani District of Haryana while the wreckage of Kazakhstan aircraft was lying close to village Birohar, Tehsil Jhajjar in the Rohtak District of Haryana.

2.23.2 **Wreckage Details of Kazakhstan IL-76 aircraft UN-76435**

The wreckage of IL-76 aircraft was spread in a trail of about 2.5. kms. in length and 2 kms. in width (between

the villages Birohar and Kachhrauli). In the beginning of trail, nose cowling portion of one of the port engines of Saudi aircraft along with few turbine blades were found. The left wing of the aircraft was found broken into three major pieces while right wing remained attached with the centre section and was found burnt near the end of the trail. The left wing root end of a length of about 9 feet was found attached to the centre section. The middle portion was of about 29 feet and had suffered fire damage and outer portion of about 30 feet in length was without any fire damage. The direction of cut on the left wing at the two places was in a direction parallel to the longitudinal axis of the aircraft. The horizontal stabiliser of the 'T' tail was found chopped off from the fin. The fuselage was broken into two portions. The front portion was of length from Station 1 to Station 29 which included cockpit. The remaining portion of the fuselage along with the part of the fin was found lying close to the front fuselage. The other portion had suffered fire damage. The damaged altimeters from the cockpit could be retrieved. All the four engines along with the cowlings had sheared off and were found dug in the ground at different places of the wreckage trail. Following are the observations on different wreckage pieces found in the trail:

Cockpit

Cockpit instruments were found in damaged condition. Following are the observations :

(a) Altimeters

(i) Pilot-in-Command Panel

Electrical altimeter Sl. No. 0513159 was found showing counter reading of 4440 meters. The barometric setting was found at 760 mm. The dial of the altimeter was found detached. Red flag was visible.

Pressure altimeter (Sl. No. 0613061) was found having baro setting of 1019 HPa and the reading on the dial was 16,700 feet.

(ii) Co-Pilot Panel

Electrical altimeter (Sl. No. Plate missing) was found indicating 4540 meters on altitude counter. The barometer counter which was found detached was showing readings 871, 760, 659, 548 mm.

(iii) Navigator's Panel

Navigator's pressure altimeter Sl.No.0508040 baro scale was set at 1013 mb. The altitude pointers were indicating altitude of 1720 feet (needles moving free).

(b) Navigator's repeater unit for height and airspeed was found broken.

(c) The combined 'g' load and angle of attack indicator reads +1.9 g and 14 degree angle of attack.

(d) Artificial horizon indicates a roll angle of 90 degree and pitch angle of 80 degree nose down attitude. Failure flag of the instrument was in view.

(e) Turn and slip indicator reads 45degree right turn.

(f) Course selector panel magnetic reading was 89 degree.

(g) Airspeed indicator of pilot was found with pointer disengaged and reading was 50 Kmph.

(h) Rate of climb/descent indicator pointer was found loose and indicating 35 meters per second descend. Pointer was free to move to zero side of the dial.

(i) Attitude Director Indicator was found with miniature aircraft symbol inverted. Command bars indicates fly left and fly down.

(j) Horizontal Situation Indicator indicated heading of 70 degree and radio station bearing 88 degree selected course 30 degree.

Lever Positions

- Slat selector lever, flap selector lever and speed brake selector lever were found in retracted position.

- Undercarriage lever was found in the UP position.

Engine Details

#1 found sheared along with pylon from wing root. There was no fire damage to the engine.

#2 found sheared off from pylon-wing attachment. There was evidence of low intensity fire close to LP compressor stage.

#3 found sheared off from pylon-wing attachment. There was no fire damage to the engine.

#4 found sheared off from pylon-wing attachment. There was no fire damage to the engine.

Fuselage

- The front fuselage section from Station No. 1 to 29 including the cockpit, the navigator station and the forward fuselage was lying on its right side with nose undercarriage in retracted position. The radome and weather radar antenna was found dislodged from the section.

- The rear fuselage section was found lying on its belly with a portion of fin and rudder with heavy fire damage. Both the main undercarriages were found in extended position.
- Tail portion of aircraft comprising of horizontal stabiliser with a part of fin was found chopped off.

Wings

Port wing was found broken into three major pieces while right wing remained attached with the centre section and was found burnt near end of the trail.

The port wing root portion was of a length of about 9 feet and was found attached to the centre section. The middle portion was of about 29 feet long and had evidence

middle portion was of about 29 feet long and had evidence of fire damage. The outer portion was of about 30 feet long which was without any fire damage. The middle portion contained inboard flap and pylon for inboard engine mounting.

The complete right wing was found with the centre fuselage section. The wing was completely burnt and the wing box was found ripped open into upper and lower sections.

2.23.3 Wreckage Details of Saudi B-747 Aircraft

Saudi aircraft wreckage was spread in a trail of 3 kms. in length and 2 kms. width near village Dhani Phogat in Bhiwani Distt. of Haryana. The wreckage trail was from East to West and it started with the bigger pieces of detached fan blades of the No. 1 and 2 engine and the detached portion of horizontal stabiliser without its left tip portion. Most of the wreckage scatter was that of the rear fuselage and of tail portion. While at the main crash site i.e. on western side, the fuselage portion along with both the wings and landing gears had nose dived and caught extensive fire, No. 3 and 4 engines had sheared off in air and were found embedded in the ground. Portion of No. 1 engine was also found at the main crash site. The cockpit portion was also buried inside the ground and was excavated with the help of machines. Number of components of the cockpit area were retrieved, however, these were in burnt and mutilated condition and no useful evidence could be obtained in the cockpit wreckage. One broken nose cowl of one of the port engine was found at the beginning of the Kazak wreckage trail. The left side of horizontal stabiliser around 18 feet which had broken off as a result of impact with the Kazak aircraft was found lying about 400 meters from the beginning of the trail near Patuwas village.

Following are the observations on the different portions of the wreckage :

Main Crash Site

At main crash site, both the burnt wings could be seen along with broken undercarriage structure and wheels. There were signs of extensive fire. One engine portion was found on the left side which was identified as portions of No. 1 engine. Little behind the main crash site, the scatter of the fuselage, seats and cargo

compartment along with the cargo containers were found.

Engines

No. 3 and 4 engines were close to the main crash site. No. 3 engine along with its cowling and pylon was lying close to the railway line which is 750 meters behind the main crash site. No. 4 engine along with cowling had dug in ground 250 meters behind the main crash site. A portion of one of the nose cowlings was found lying at the beginning of Kazak wreckage trail. The fan assemblies of both the port engines which had detached in air from its engines were found lying in the beginning of the trail on its left side on the outskirts of village Patuwas. Core portion of one of the port engines was lying in a wreckage trail behind the railway line in village Patuwas. The wreckage scatter of the broken engine pieces of the port engines indicates their break up in air. The fan blades of the port engines indicated that the engines were at power at the time of their break up.

Tail Portion

a) Horizontal stabiliser with its left side tip portion of about 18 feet length chopped off was found lying in the beginning of the wreckage trail at about 1.26 kms behind the main wreckage. The actuator of the stabiliser was found detached from the structure. The cut out portion of the left side of horizontal stabiliser of about 18 feet was found lying on left side of the wreckage trail near Patuwas village around 2.4 kms behind the main crash site. The direction of cut of the left side of horizontal stabiliser appear to be parallel to the longitudinal axis.

b) The fin and the rudder were found detached in the wreckage scatter at about 1.5 kms behind the main wreckage.

Fuselage

a) Rear fuselage had broken into number of pieces and was found scattered upto the main crash site.

b) The front portion of fuselage along with the wings was completely destroyed as a result of impact and fire damage.

2.23.4 **Indications from the Wreckage Pattern**

The presence of Saudi engine sliced nose cowl in the beginning of Kazak wreckage, in-flight break up of fan assemblies of Saudi aircraft port engines, and slicing of port wing of Kazakhstan aircraft at two places are indicative of the hit of port wing of Kazakhstan aircraft with the port engines of saudia aircraft as a first impact between the two aircraft. The cut on the left side of the horizontal stabiliser of Saudi aircraft and chopping of horizontal stabiliser from the 'T' tail of Kazakhstan aircraft appear to be subsequent to the first impact.

2.24 **Medical and Pathological Information**

Dead bodies of crew and passengers of Kazak aircraft were transported to the Rohtak Medical College Hospital. Bodies were mutilated and charred. Post mortem on bodies was carried out at Rohtak Medical College in the presence of the Asstt. Director General, Medical Services of DGCA.

2.24.1 Following tissues of the remains of Capt. Cherepanov, PIC and Mr. Chuprouv, flight engineer of Kazak Airlines were sent to Institute of Aerospace Medicine (IAM), Air Force, Bangalore for histopathological examination :

(i) Both lungs
(ii) A part of trachea
(iii) Heart - ruptured
(iv) A portion of aorta
(v) Both Kidneys
(vi) Adrenals

From the reports of the pathologist of IAM on microscopic and toxicological/biochemical investigation, the following observations are noted :

2.24.2 **Capt. Cherepanov, PIC**

(i) Traumatic pneumonosis appears to be due to aircraft crash impact forces.

(ii) Mason's grade 1+ atheromatous change in a pre-existing disease. It is an incidental finding and appears to be non-contributory to the accident causation.

(iii) There is no evidence of carbon monooxide poisoning or alcohol consumption.

(iv) Lactic acid level is within normal limits indicating no evidence of hypoxia.

2.24.3 **Mr. Chuprouv, Flight Engineer**

(i) Corpora amylacea in the lung is an incidental finding and non-contributory to the accident causation.

(ii) There is no evidence of carbon monoxide poisoning.

(iii) Histopathologically, all tissues examined appear normal.

The comments of Wg. Cdr. R. Kapur, Asstt. Director General Medical Services, DGCA, in this regard, are given below :

> "The post mortem examination conducted on the body of pilot of Kazak aircraft Capt. Cherepanov revealed no evidence of incapacitation, carbon monoxide, hypoxia or any pre-existing disease which may have contributed to the accident. No evidence of alcohol was found in the body contents.
>
> The post mortem report on other occupants of Kazakhstan aircraft reveals multiple fractures and injuries suggestive of crash forces which were beyond survivable limits".

2.25 **Fire**

Both the aircraft appear to have caught fire immediately upon collision. This is evident from the eyewitness statements and from the statement of the U.S. Air Force aircraft crew recorded on frequency 127.9 MHz. Some wreckage pieces lying on ground had fire marks without continuity of fire trail between them. This indicates that these pieces were on fire when impacted the ground.

The main fuselage of Saudi B-747 aircraft was destroyed due to impact and fire.

The main fuselage of Kazak IL-76 aircraft caught fire and fell a few hundred feet away from the front fuselage portion along with cockpit which got separated. While the main fuselage got engulfed in fire, the front portion was severely damaged due to impact.

At Saudi accident site, fire tenders from the local fire stations were put into service to extinguish the fire.

At Kazak accident site, fire had ceased when the fire tenders reached the site and so were not put to use.

2.26 **Survival Aspects**

Both the aircraft disintegrated after the mid-air collision. All the occupants on board both the aircraft died due to fire and impact on ground.

Rescue action was immediately initiated and a team of local police authorities and villagers reached the site soon after the accident.

According to Shri Robey Lal, Member (Operations), Airports Authority of India, two teams of officials including doctors and ambulances with emergency medical supplies departed for the site immediately upon receipt of the information about the accident. One of the teams went to the Kazak site and the other team proceeded to the site of Saudi accident. They reached the site at 2350 hours (IST). According to him, at the Saudi site, there were large number of police deployed and they were being helped by many local residents of the surrounding villages for recovering the bodies. The bodies were removed under police control to a temporary morgue set up

at the Government Hospital, Dadri. Though there were rumours of 2 to 3 survivors, he further stated that as per the Supdt. of Police, there were none and so, Medical Assistance was not found necessary. He also confirmed that local fire tenders and ambulances were on site.

According to Shri Robey Lal, the team which proceeded to the Kazak crash site informed that there were also no survivors and there had been no requirement for any medical assistance at that site also.

As per the documents forwarded by Dr. C.M. Sharma, Senior Medical Officer of the Airports Authority of India, Dr. B. Bhatnagar rushed in Airports Authority Ambulance along with Dr. Chawla and Dr. P. Arora at Charkhi Dadri accident site. There were no survivors found but only badly mutilated bodies.

According to Dr. (Mrs.) P. Arora, All India Institute of Medical Sciences, Ram Manohar Lohia Hospital and the Army Hospitals were alerted to receive possible casualities. Further, she stated that she reached Kazak accident site near village Birohar in District Rohtak and found no survivors. She along with her team witnessed the bodies smashed in wreckage and few scattered around. According to her, the Red Cross Ambulance was also seen at the site.

According to Shri Robey Lal, the Emergency Control Room at International Airports Division was set up under the supervision of Deputy General Manager (Operations) for answering queries. Further information counters were set up at the Departure Terminal II for answering queries of relatives and friends of the passengers of the aircraft.

According to District Authorities of Rohtak where the wreckage of Kazak IL-76 fell, two reserve each from Sonepat, Panipat and three reserve each from Rohtak, Jhajhar, Beay and Saldhewas under the supervision of two District Supdt. of Police, were deployed.

Eight doctors and three nurses were called from Red Cross.With the help of police, 37 dead bodies were recovered and post mortem was conducted at Medical College, Rohtak. Subsequently the bodies were handed over to the representatives of the airline through the Embassy of Kazakhstan.

The accident was not survivable.

CHAPTER - III

Court Procedure & Proceedings

CHAPTER III-1

PARTIES REPRESENTED

PARTICIPANTS

Name of the party	Represented by
The Republic of Kazakhstan through Mr.B.U.Salimov, Actg. DGCA Accredited Representative	M/s.Mc Guire Woods, Battle & Boothe, Richmond, Virginia. Mr.John W. Barnum Mr.Thomas E. Spahn, Ms.Olga S. Elyea
Kazakhstan Airlines	M/s.D.C.Singhania & Co. Mr.D.C.Singhania, Mr.Amitabh Chaturvedi.
The Kingdom of Saudi Arabia through Capt.Ommar S. Barayan, Accredited Representative, and Capt. Saad Al Shehri Advisor.	
Saudi Arabian Airlines	M/s.Lalit Bhasin & Co. Mr.Lalit Bhasin, Ms.Neena Gupta, Ms.Kiran Kalra
Director General of Civil Aviation Delhi (India)	M/s.R.K. Anand & Co. Mr.R.K.Anand, Mr.Munish Malhotra,
Airports Authority of India	Air Cmde (Retd) N.A.K.Sarma
Boeing Company	M/s.R.S.Suri & Co. Mr.R.S.Suri

INTERVENOR

ATC Guild (India)	Sh.Brijendra Shekhar Shukla, General Secretary, ATC Guild.

CHAPTER-III-2

PROCEDURE ADOPTED BY THE COURT :

3.1 The Court of Inquiry was constituted under Rule 75 of the Aircraft Rules, 1937, relevnt extract whereof reads as under :

> 75. **FORMAL INVESTIGATION**-- Where it appears to the Central Govt 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 74 by order, direct a formal investigation to be held and with respect to any such formal investigation the following provisions shall apply, namely-
>
> (1).....
>
> (2) The Court shall hold the investigation in open court in such manner and under such conditions as the Court may think fit for ascertaining the causes and circumstances of the accident and for enabling it to make the report hereinafter mentioned:
>
> XXXX XXX XXX XXXX
>
> XXXX XXX XXX XXXX
>
> (6) The Court shall make a report to the Central Govt stating its findings as to the causes of the accident and the circumstances thereof and adding any observations and recommendations which the Court thinks fit to make with a view to the preservation of life and avoidance of similar accidents in future, including, a recommendation for the cancellation, suspension or endorsement of any licence or certificate issued under these rules."

3.2 Ordinarily, the investigation to be held by the Court is an open court investigation, the manner and conditions wherein are to be determined by the Court guided by the paramount consideration of enabling a report being made to the Central Govt stating its finding as to the causes and circumstances of the accident under investigation. The Court may make recommendations and add its observations.

3.3 Chapter 1 of DOC 6920-AN/855/4 (Manual of Aircraft Accident Investigation) approved by and published under the authority of International Civil Aviation Organisation (ICAO) provides as under :

PURPOSE OF THE INQUIRY

> The fundamental purpose of inquiry into an aircraft accident is to determine the facts, conditions and circumstances pertaining to the accident with a view to establishing the probable cause thereof, so that appropriate steps may be taken to prevent a recurrence of the accident and the factors which led to it. An equally important purpose is to determine the facts, conditions and circumstances pertaining to the survival or non-survival, of the occupants, and the crashworthiness of the aircraft. The nature of the inquiry into an aircraft accident should not be accusatory as the object is to take remedial rather than punitive action; similarly the assessment of blame or responsibility should not be included in the duties of an aircraft accident investigation authority since this function is normally the prerogative of the judicial authorities of the State concerned. Nevertheless, it is unavoidable that acts or omissions, by

individual persons or organizations, are sometimes clearly revealed and in such instances it is the duty of the inquiry to say so. Any such statement should not confuse the purpose of the aircraft accident investigation which is primarily to indicate what caused the accident rather than who caused it : this should rightly be for others to decide.

Aspects of safety totally unconnected with the circumstances or chain of events leading to the accident are often revealed during the investigation with a resultant benefit in terms of effective accident prevention. Investigators should not be inhibited from investigating these matters or from drawing attention to them merely because they are not related to the cause of the accident.

Reduced to simple terms, the investigator has to determine what happened, how it happened, and why it happened, applying these questions not only to basic cause but to all aspects relating to safety including survival of occupants. In doing this he must seek out, record and analyse the facts, draw conclusions and, where appropriate, make recommendations.

The basic cause of an accident and the remedial action necessary to ensure that it will not recur does not always emerge from the physical facts of the case. For example, a failure of some mechanical part may be due to a failure to inspect or faulty inspection technique in a factory or a maintenance shop where the defective part should have been detected thereby preventing its failure in service. Similarly, if human error appears as a possible cause of the accident all factors which may have influenced the actions should be examined. The inquiry should not cease if or when it is established an error has been made : the inquiry should endeavour to establish why the error occurred. Poor design, indifferent human engineering, inadequate or improper operational procedures could well have confused or misled the person. Experience has shown that the majority of aircraft accidents have been caused or compounded by human error, often by circumstances which were conducive to human error; this applies to design, manufacture, testing, maintenance, inspection and operational procedures both ground and air. Identification of this element is frequently difficult but it may be revealed by careful, skillful and persistent investigative methods.

Some aircraft accidents have resulted from organizational defects or weaknesses in management; for example, an operator may have prescribed or condoned procedure not commensurate with safe operating conditions in practice. Similarly, ambiguous instructions, and those capable of dual interpretation may also have existed; these factors may well have stemmed in the first instance from uncritical scrutiny by regulating authorities. It may therefore be necessary to inquire closely into other organizations or agencies not immediately or directly concerned with the circumstances of the accident but where action, or lack of it, may have permitted or even caused the accident to happen.

WHERE the cause of an accident is obscure it may be necessary to pursue as many hypotheses as could seriously be regarded as possibilities and each pursued to the limits of its usefulness, or to the limit where it can be excluded as a possibility. This approach will often result in some degree of speculation and prolonged exploration but it may be the only course open to the investigator. By carefully considering each possibility in the light of the evidence adduced, and the existing state of aeronautical knowledge, a number of the hypotheses will be eliminated: the credibility of those which survive the process is thereby increased and experience has shown that these will generally relate to one particular area or group of possibilities.

Findings which have been arrived at by more than one line of inquiry, by more than one person each reasoning independently, are more likely to be correct than those conclusions arrived at by pursuing one narrow field of activity.

3.4 There are no set rules or procedure laid down. The court of Inquiry is not bound by rules of evidence. However, the court has to observe and comply with the principles of natural justice. It has to so conduct itself as to facilitate influx from all and any

source of any material which would be useful to it for investigation of the accident. At the same time it has to be fair to all concerned. The participants and the observers must be afforded opportunity of participating and observing respectively. Any one interested or likely to be effected by the Court of Inquiry proceedings, its findings, conclusions, observations and recommendations, must be afforded an opportunity of hearing. Laying down of any set procedure appears to have been consciously avoided. It is obvious that the manner and the circumstances in which an accident may take place are myriad and defy imagination. It has to be left to the wisdom and experience of the court entrusted with the formal investigation to appropriately devise its procedure so as to suit the exigencies of the situation and demands of the circumstances of each individual accident/incident; the paramount consideration being to ascertain the causes and circumstances of the accident. The object is not to find fault with any one much less to fix the liability for the accident. The object is ideal and humanitarian. A court has to make its recommendations and observations in the interest of humanity, safety of persons and property so that such accidents do not recur in future. The

object of investigation being one to which none can raise an exception, the Court can justifiably expect each one concerned rendering his wholehearted cooperation and assistance enabling it to perform its function and achieve the objective successfully, fruitfully and expeditiously. There are no adversaries before such a court.

3.5 In the proceedings the court has, therefore, from the very beginning maintained complete transparency. Participation by all concerned was invited at every stage of the proceedings. This would be evident from the record of the proceedings, also reflected by the narration of relevant events and proceedings contained in the report. Such procedure did bring out the desired result. At every crucial stage of proceedings the parties could raise their contentions, put forth their objections and make suggestions which were all considered then and there and dealt with suitably. All the material constituting evidence in the investigation was collected in the presence of the parties. It was acceptable to them as evidence. At the hearing, all the parties agreed to the material collected by the court being read as evidence and made use of by the

Court dispensing with the necessity of recording evidence either viva-voce or on affidavits. Obviously, none insisted on exercising right of cross-examination, nay none even felt its need. All the documents were therefore marked as exhibits/articles with the consent of the parties. Substantial time, energy and expenditure which would have been consumed and involved in recording the statements of the witnesses (some of whom were bound to be from foreign countries), could be saved. The parties made their submissions- oral and written -which were welcome by the Court.

3.6 Indeed, the basics of natural justice were complied with. All the material and relevant information on which the court proposed to base its findings and conclusions were made available to the parties.

3.7 They were allowed to have their say and offer comments thereon, which they did. As the facts show, the cause of accident was obscure. The procedure adopted by the Court enabled the parties concerned constructing their respective hypotheses as could seriously be regarded as possibilities based on the material collected. Undoubtedly, this approach

involved some degree of speculation and exploration. Eye witness account had stood completely eliminated so far as the cause and circumstances of the accident were concerned. Hence this was the only course open to the Court. The Court has thus reached its conclusions on the lines contemplated by Chapter 1 of DOC 6920.

3.8 It may not be out of place to mention that at the very commencement of the oral hearings before the court, all the parties without exception- unhesitatingly expressed their approval and appreciation of the procedure adopted by the Court and requested that the same be placed on record.

CHAPTER III-3

PROCEEDINGS OF THE COURT

3.9 Soon after notification of the constitution of the Court on 15.11.96; the site of the accident was visited on 16.11.96, and again on 25.11.96. In between, there was another visit by Assessor Air Cmde T. Pannu on 18.11.96

3.10 On 20.11.96, the ATC tapes were played before the court. It was decided to have the transcript of the tapes prepared under the supervision of the Assessor Air Cmde T.Pannu.

3.11 A public notice (placed at App._A) was issued on 21.11.96. It was published on 25.11.96 in leading national dailies of India having wide circulation in Delhi and Haryana. The Republic of Kazakhstan published the notice in its newspapers on 25th/26th December, 1996. The Kingdom of Saudi Arabia, however, made the publication on 16th/18th January, 1997.

3.12 The two sets of black boxes having been retrieved, information was gathered on availability of

facilities for decoding of the DFDR/FDR. On 21.11.96, the Court held a meeting whereat a team of experts from National Aeronautical Laboratry (NAL), Bangalore headed by Dr Nagabhushan also participated. It was confirmed that the Boeing 747 DFDR could be decoded by NAL at Bangalore with the assistance of equipment available with Air India at their Avionics Overhaul Division, Bombay. As to the FDR installed on IL-76 it was pointed out that since this type of aircraft was in the fleet of Indian Air Force the facility for decoding could be explored with them.

3.13 In an all-party hearing on 28.11.96, both Kazak and Saudi Airlines expressed their apprehensions about the adequacy of the facilities with the NAL, Bangalore compared with the advanced techniques and equipment available overseas. Both the sides insisted on the decoding being done outside India. IAF could not readily confirm its ability to help in decoding the model of the FDR retrieved from the ill-fated IL-76 aircraft. On an overall assessment of the information made available, the views expressed by the parties and the background of the nature of the accident wherein the black boxes were the most vital evidence, rather the only piece of evidence

available, it was decided that IL-76 black boxes be decoded at the Interstate Aviation Committee (IAC), Moscow and Boeing 747 black boxes be decoded at Air Accident Investigation Branch (AAIB), Farnborough, UK in the presence of such parties as may wish to remain present. This was agreed to by all concerned.

3.14 The initial programme of the court proceedings which were fixed for decoding of the black boxes within the country by moving to Avionics Overhaul Division of Air India Bombay, NAL Bangalore and IAF Station Chandigarh had to be cancelled and a fresh itinerary was chalked out.

3.15 The Court was of the opinion that before moving the black boxes outside the country it would be advisable to have copies of the original tapes prepared which could be taken out for decoding outside the country or else the originals could be taken out leaving the copies behind so as not to take any risk of any piece of evidence being lost or damaged in transit. However, the agencies (i.e. IAC and AAIB) which were to be entrusted with and involved in the task of decoding were of the opinion that the originals must be made available to them.

3.16 The IAC Moscow sent its experts with necessary equipment to Delhi for preparing copies of the FDR and CVR tapes of IL-76 aircraft. However, efforts at having similar exercise of preparing copies of DFDR and CVR tapes of Boeing-747 at Bombay could not materialise for want of positive response from M/s.Lockheed Martin and M/s.Fairchild, the manufacturers.

3.17 The Court visited IAC Moscow where decoding of IL-76 black boxes was carried out on 13,14 and 15 Feb 97. Preliminary analysis report and retrieved data were made available, which, along with Boeing black boxes, were carried to London on 16.2.97. A supplementary report from IAC was to follow within a fortnight so that systemic and incidental errors including faults, if any, could be removed and the compliance of all the parameters registered could be checked as suggested by them. The four altimeters retrieved from IL-76 aircraft were also entrusted to IAC Moscow for research and analysis which, as was assured, would be accomplished through the State Scientific Research Institute, a sister organisation of IAC. The Supplementary /Final Report dated 27.3.97 was

received in Delhi through the Indian Embassy only on 29.3.97.

3.18 Decoding of Boeing-747 black boxes was carried out at AAIB, Farnborough from 17.2.97 to 24.2.97. The data made available by IAC Moscow was also handed over to AAIB so as to cross check and synchronise all the data retrieved.

3.19 Besides various discussions from time to time, a final meeting was held with AAIB experts on 24.2.97 when they handed over their report accompanied by data retrieval documents. The AAIB assured the Court of sending a supplementary report after further research and intensive study was carried out. The supplementary Report dated 21.3.97 was received in Delhi on 23.3.97.

3.20 On 27.3.97, it was decided to have a pre-hearing session with all the parties on 8.4.97, notices for which were given. On 8.4.97 the Court made available to all the parties participating in the proceedings copies of all the material collected by the Court which was sought to be relied upon at the hearing. The participating parties were asked to file their

respective statements on affidavits latest by 21.4.97 containing the following (inter alia) :

(i) Version of the party as regards the accident to the extent to which it relates to or concerns that party;

(ii) Comments/submissions of the party on the evidence/ material available before the Court of Inquiry;

(iii) the pleas sought to be urged before the Court of Inquiry;

(iv) Suggestions which the party proposes to make for the purpose of inclusion in the recommendations to be made by the Court of Inquiry;

(v) Documents/statements which the party may propose to be placed before the Court of Inquiry;

It was further directed that :-

(i) Statements/documents to be filed shall be prepared in sets of 15 each enabling exchange amongst all the participants;

(ii) Statements/documents in a language other than English must be accompanied with English

translation along with verification by the Translator.

The parties were advised to collect the copies of the statements filed by other parties between 3 and 5 P.M. on the same day.

The parties were allowed liberty of inspecting the originals of the material collected by the Court of Inquiry subject to previous appointment with the Secretary.

3.21 On 25.4.97, the second pre-hearing session was held for formulating points at issue and laying down procedure of hearing.

The proceedings of 25.4.97 being material are reproduced in full :

> At the outset the court thanked all the parties and their eminent counsel for the cooperation extended by them in expediting the Court of Inquiry proceedings. It was emphasised that the Court was inquiring into one of the most tragic events in the history of civil aviation resulting into loss of human life. The object of the constitution of the Court of Inquiry is to inquire into the causes and circumstances of the tragic accident and to make observations and recommendations for future so as to avoid recurrence of such accidents. The Court of Inquiry is not to fix the fault or blame on any one. It is expected that the parties would continue to

extend their cooperation in expediting the hearing and thereby reaching the avowed object of the Court of Inquiry at an early date.

The evidence and the documents collected by the Court of Inquiry have been made available to the parties. Liberty has been allowed to the parties to inspect the originals as well. Pursuant to the order dated 8.4.97 the parties have filed their affidavits. None of the parties has laid any challenge to the correctness of the factual data retrieved with the assistance of IAC Moscow and AAIB Farnborough. In the light of the statements of the participating parties as set out in their respective affidavits it is considered not necessary to record any oral evidence. The reports/ documents can be marked as exhibits. The participating parties have expressed their agreement to such a course being adopted.

As to the procedure to be followed at the hearing, after hearing the parties and their learned counsel, it is decided that the oral hearing would commence w.e.f. 28.4.97 as per the following calendar which suits convenience of all the parties :

DAY AND DATE		PARTY TO BE HEARD
MONDAY	28.4.97	Republic of Kazakhstan
TUESDAY	29.4.97	Kazakhstan Airlines
WEDNESDAY	30.4.97	Saudi Arabian Airlines
THURSDAY	01.5.97	Saudi Arabian Presidency of Civil Aviation (PCA)
FRIDAY	02.5.97	Airports Authority of India
MONDAY	05.5.97	DGCA, India.
TUESDAY	06.5.97	Boeing Commercial Airplane Company ATC Guild.(India)

The hearing shall be on the following issues :

1. What are the causes of the accident and the circumstances thereof ?

2. In the background of the facts and circumstances and causes of the accident, what are the recommendations that are required to be made so as to avoid recurrence of such accidents in future ?

Mr Salimov, accredited representative of Kazak Republic and Mr Amitabh Chaturvedi advocate for Kazak Airlines have assured to make available a corrected/revised transcript of IL-76 CVR and English translation of the relevant portions pointed out during the course of hearing.

Air Cmde Sarma also insisted on the Kazak Airlines filing IL-76 cockpit layout plan including crew stations and their respective instrument panels. Mr John Barnum has assured to have the same filed at the earliest.

Mr John Barnum submitted that a copy of DFDR tape of IL-76 be made available to his party. The tape has been read out and decoded at IAC Moscow, a centre chosen by Kazak side and in the presence of all the parties. The data retrieved and print-outs have been made available to all the parties. It is not necessary to supply copy of the DFDR tape. Saudi

Arabian Airlines and Kazak Airlines have both moved applications seeking direction of the court for allowing visit of their experts to ATC facilities at Delhi Airport.

Air Cmde Sarma submitted on behalf of Airport Authority of India that this may lead to a roving inquiry and an attempt at finding out such facts which travel beyond the scope of the Inquiry. After hearing the parties, it is directed that :

1. The Airports Authority of India shall permit visit by the ATC experts/ representatives of Saudi Arabian PCA/Airlines, Kazakhstan Republic/ Airlines on Thursday the 1st May, 1997 at 3.00 pm; each party to restrict the number of its representatives to four. The Boeing company do not wish to join.

2 The visit shall be confined to Aerodrome Control Tower, Radar/ Approach control and Area control Centres.

3. The visit shall be under the control and supervision of the Assessor, Air Cmde T. Pannu.

4. The AAI shall file before the Court a statement of Local ATC Operating Instructions/ Manual. So much part of the Manuals/ Instructions as are standardised by ICAO and published (hence even otherwise available to everyone) need not be filed.

3.22 The hearings were held in open court on 28,29,30 April and 1,12,13,14, and 15 May, 1997. Each of the parties addressing the Court filed a brief synopsis of its submissions at the beginning and was allowed liberty of filing its detailed written submissions at the end of the hearing which the parties did.

3.23. The manufacturers of IL-76 must have been aware of the proceedings from the very date of the accident and also through publication of notice in Kazakhstan. At one stage of the proceedings an individual notice was also given. However, they chose not to participate in the proceedings.

3.24. ATC Guild of India represented through Shri Brijender Shekhar Shukla, General Secretary sought intervention in the proceedings which was allowed.

CHAPTER III-4

LIST OF AFFIDAVITS FILED BEFORE THE COURT

For **AIRPORTS AUTHORITY OF INDIA**

Mr P.C. Goel. Director Air-Routes & Aerodromes (Operations)	dt.17.12.96

For **SAUDI ARABIAN AIRLINES CORPORATION**

Mr Ali Abdullah Milaat General Manager of Technical Quality Assurance	dt 21.12.86
Capt Mohammed Ali Jamjoom, General Manager Flying,	dt 23.12.96
Capt Saad Ali Saad Alshehri General Manager (Corporate Safety)	dt 20.4.97

For **KAZAKHSTAN AIRLINES CORPORATION**

Mr Sergei Kolodzneyi Chief Pilot Kazakhstan Airlines	dt 19.4.97
Wg Cdr B K Khanna Consultant	dt 19.4.97

For **KAZAKHSTAN REPUBLIC**

Mr Anvar Abdullaevich Dayanov Dy Dir of State Aviation Supervision of the Ministry of Transportation and Communication.	dt 28.4.97
Mr Bekpulat Salimov, Chairman of the Committee for Utilisation of Air Space and Civil Aviation of the Ministry of Transport and Communication.	dt 24.4.1997

For **AIR TRAFFIC CONTROLLERS GUILD (INDIA)**

Mr Brijendra Shekhar, Genl Secy ATC dt 21.4.97

for **NTSB, WASHINGTON (AT THE INSTANCE OF COURT)**

Capt Timothy J. Place,
Aircraft Commander dt 15.11.96.

CHAPTER III-5

LIST OF DOCUMENTS MARKED AS EXHIBITS

S.No.	Exh No.	DESCRIPTION OF ARTICLE
1.	1	Factual Information Report of Capt KPS NAIR, Inspector of Accident.
2	1A	ATC Tape Trascript
3.	2	Report from IAC Moscow dated 15.02.97
4.	3	Report from IAC moscow dated 24.3.97 (alongwith English Translation)
5	3A	Report on Altimeter examination (along with English Translation.)
6.	3B	CVR Tape Transcript IL-76 aircraft
7.	3C	FDR Print out IL-76 aircraft
8.	4	Report from AAIB Farnborough dt 24.2.97
9.	4A	CVR Tape Transcript B-747 aircraft
10	4B	DFDR print out B-747 aircraft
11	5	Report from AAIB Farnborough dt 13.3.97
12.	6	Report from AAIB Farnborough dt 21.3.97
13.	7	Meteorological report dated 22.4.97.
14	8	Meteorological Report dated 10.6.97
15	8A	Satellite Picture of Weather over Indian Sub-Continent
16	8B	Satellite picture of weather over crash area.
17	9	Consolidated Tape Transcript Table
18	10	Cockpit Layout IL-76 aircraft

CHAPTER III-6

LIST OF ARTICLES

S.NO.	Art No.	DESCRIPTION
1.	1	ATC TAPE SPOOLS (FOUR)
2.	2	ATC TAPE AUDIO CASSETTE
3.	3	CVR TAPE SPOOL IL-76 (ORIGINAL)
4.	3A	CVR TAPE SPOOL IL -76 (COPY)
5.	4	CVR AUDIO CASSETTE
6	5	FDR SPOOL IL-76 (ORIGINAL)
7.	5A	FDR SPOOL IL-76 (COPY)
8.	6	FDR (SELECTED PARAMETERS) DATA FLOPPY IL-76
9.	7	CVR TAPE SPOOL B-747 (ORIGINAL)
10	7A	CVR TAPE SPOOL B-747 (COPY)
11	8	CVR TAPE AUDIO CASSETTES B-747 (TWO)
12.	9	DFDR SPOOL B-747 (ORIGINAL)
13	9A	DFDR SPOOL B-747 (COPY)
14.	10	COMPUTER DISC CONTAINING SELECTED DFDR PARAMETERS
15.	11	CVR IL-76 AIRCRAFT AS OPENED FOR PREPARING COPY AT RADIO SHOP IA NEW DELHI
16	12	FDR IL-76 AS OPENED FOR PREPARING COPY AT RADIO SHOP IA NEW DELHI.
17.	13	CVR B-747 AS OPENED FOR DECODING AT AAIB FARNBOROUGH
18.	14	DFDR B-747 AS OPENED FOR DECODING AT AAIB FARNBOROUGH

19.	15	BOX CONTAINING FOUR ALTIMETERS RETRIEVED FROM WRECKAGE OF IL-76 AND EXAMINED BY STATE SCIENTIFIC RESEARCH INSTITUTE AERO NAVIGATION, FEDERAL AVIATION DEPARTMENT OF RUSSIA.
20	16	VIDEO RECORDING OF WRECKAGE OF B-747 DATED 16.11.1997
21	17	VIDEO RECODING OF WRECKAGE OF IL-76
22	18	VIDEO RECORDING OF OPENING OF BLACK BOXES OF IL-76 AT RADIO SHOP IA, NEW DELHI DT 11.1.97
23.	19	VIDEO RECORDING OF OPENING OF BLACK BOXES B-747 AT AAIB FARNBOROUGH DT 17.2.97 (AAIB)
24.	20	VIDEO RECORDING OF INSTRUMENT DISPLAY OF B-747 AIRCRAFT (AAIB)
25	21	VIDEO RECORDING OF INSTRUMENT DISPLAY OF IL-76 AIRCRAFT AND TRACK PLOT.

CHAPTER-IV

Analysis

CHAPTER III-7

PLACES (OTHER THAN SITE OF ACCIDENT) VISITED BY THE COURT

SL NO.	PLACE	DATE OF VISIT	PURPOSE
1.	DELHI AIRPORT	19.11.96	Familiarisation
2	AIR FORCE STATION ARJANGARH	18.12.96	Familiarisation with SSR equipmen
3.	DELHI AIRPORT ATC	19.12.96 & afterwards	Preparation of AT transcript and inspection of controlling standards
4.	AIR INDIA BOMBAY	22.12.96	Familiarisation with Boeing-747 cockpit and DFDR system operation.
5.	DELHI AIRPORT NEW ATC	24.1.97 10.2.97	Familiarisation with & inspection of new set up
6.	ATCC MOSCOW	13.2.97	Familiarisation with ATCC set up.
7	HEATHROW AIRPORT & LONDON AREA AND TERMINAL CONTROL CENTRE	20.2.97	Familiarisation with ATC set up
8.	ARC IL-76 BASED AT PALAM.	5.3.97 & 29.5.97	Familiarisation with on-board equipment.

CHAPTER IV-1

ANALYSIS - MAIN ISSUES

4.1 As the facts of the accident show, all possible direct evidence has stood excluded by the cruel hands of death. There has been no survivor. The cause and the circumstances of the accident have to be determined from circumstances as deducible from the data retrieved from the two sets of black boxes of the two ill-fated aircraft.

4.2 The cause of the accident is obscure and therefore, as contemplated by Chapter I (Purpose of the Inquiry) of DOC. 6920, it became necessary to pursue as many hypotheses as could seriously be regarded as possibilities and then pursue each to the limits of its logical end, this being the only course open. Keeping this in view, all the participants were asked by the Court on 25.4.97 to set out their respective and possible versions of the accident on the basis of the material available before the Court or proposed to be brought on record.

4.3 The hypotheses/theories which were suggested by the

parties before the Court may be set out by borrowing from each of their statements,as under :-

(4.3/A) REPUBLIC OF KAZAKHSTAN AND KAZAKHSTAN AIRLINES (KAZAK SIDE) THEORY

"The cause of the collision was the fact that the Kazakhstan Airlines was flying below 15000 ft, according to FDRs of both aircraft, probably as low as 14100 ft. The reason that the KAZAK PLANE was at that altitude was the weather conditions at the time.

There were two weather conditions that effected the Kazak crew's ability to avoid the collision : (i) there were clouds which prevented the aircraft from seeing each other (ii) both aircraft entered turbulence immediately before the collision which in the case of the Kazak aircraft forced it down by as much as 1000 ft.

Contributing causes for collision and the main reason that the Kazakhstan crew were unable to avoid the collision were the short comings of the ATC system of Delhi airport and the failure of the ATC to (i) issue adequate and timely warning of the approach of the Saudi aircraft on a collision

course and (ii) instruct both aircraft to perform a common and prudent collision avoidance manouvre."

4.3/B THE KINGDOM OF SAUDI ARABIA AND SAUDI ARABIAN AIRLINES (SAUDI SIDE) THEORY

"Lack of coordination in the cockpit and poor cockpit resource management, procedures and communications together with confusion in the cockpit of the Kazak aircraft may provide the cause.

ATC equipment, systems, single approach and departure corridor (G452), shift manning, working conditions, the overall record of air misses and operational procedures may have contributed to the cause of the accident, which all need to be investigated."

4.3/C AIRPORTS AUTHORITY OF INDIA'S THEORY

"The collision occurred close to FL 140 to which the Kazak aircraft had descended, unauthorisedly departing from the assigned FL 150 and this happened because of the inadequacy of knowledge of aviation English on the part of the IL-76 cockpit crew; absence of proper flight discipline and proper crew task sharing (airmanship) on the part

of the crew of IL-76.

4.4 All the relevant data from the DFDR/FDR has been successfully retrieved with the help of the two expert accident investigating agencies- IAC, Moscow and AAIB, Farnborough (Hants) UK. The CVRs of the two ill-fated aircraft could also be read out and transcripts of the recordings prepared. Transcript of ATC tape recordings was also prepared. The three recordings tally with one another and cross confirm the conversation so as to project a picture of what transpired amongst the ATC Delhi, IL-76 and Boeing-747. The recordings also provide a glimpse into a scenario of each of the cockpits of the two aircraft at the crucial time of the accident and just preceding it. Inferences have to be drawn by analysing and appreciating the phraseology used, the utterances made and the silence observed by the crew members, their moods as reflected in the tone or accent of speech etc.

4.5 We proceed to marshal the material available from the following points of view :

(i) At what flight level did the accident take place?

(ii) How and why did the two aircraft reach

the same flight level leading to collision?

(iii) Could air turbulence have caused the loss of altitude resulting in the collision?

4.6 The analysis of the data retrieved from the DFDR/FDR of both the aircraft points out to the accident having taken place at FL 140 (or in close proximity of FL 140). On receipt of reports from the two investigating agencies, not only it was not disputed but rather it became an admitted fact agreed to by all the parties before the court that this was the flight level at which the two ill-fated aircraft were at the time of collision. The Court too having independently reviewed the data retrieved from the two FDRs is of the opinion that FL140 was indeed the level at which the two aircraft collided.

4.7 The IAC Moscow has concluded [See: Appendix B-2(T)]:

> The altitude at the moment of collision was 4300 +100/-200 m. as per the data from MSRP recordings taking into account the errors and calibrated curve of the sensor.

4.8 It was also opined by the IAC :

> "In order to determine the collision altitude more accurately it is necessary to analyse the results of the decoding

of the flight parameters of IL-76 and Boeing-747 aircraft together."

4.9 It was the above observation made by the IAC which primarily persuaded the Court in making available the data released by IAC, Moscow to AAIB, Farnborough where the Boeing-747 black boxes were decoded.

4.10 The AAIB, Farnborough analysed the data retrieved from IL-76 FDR and concluded that the recorded altitude at the time of collision was 14100 ft but found the expected tolerances in measurement and recording as +/- 500 ft. Thus, the actual altitude was likely to have been between 13600 and 14600 ft. As to Saudia B-747 aircraft the AAIB has found that the overall accuracy could be +/- 120 ft keeping in view possible tolerances within the analoge to digital conversion process. Immediately prior to collision the Saudi aircraft recorded altitude of 13900 ft. This would mean that true altitude at collision was between 13780 and 14020 ft. The AAIB made a comparison of recorded altitudes with the expected values on the accident flight take off and the cruise levels on several flights and found that at the collision altitude the DFDR of B-747 was

under-reading by 100 ft which was within the expected tolerance level. It thus follows that the Boeing 747 was at (13900 ft recorded +100 ft correctional factor) 14000ft i.e. FL 140 (See-Appendix C-3).

4.11 Here itself we may deal with Report on Scientific analysis of Altimeters.

4.12 All the three altimeters of Saudi Boeing-747 were destroyed by fire after impact on ground.

4.13 Four Altimeters of Kazak IL-76 were recovered in damaged condition. There were two mechanical (barometric) foot-altimeters and two electric (servo) altimeters with metric scale. All the four altimeter instruments had been sent to the State Scientific Research Institute of Aero Navigation (SSRIAN) through the IAC, Moscow for scientific examination. Their report [See- Appendix-B-3(T)] has given the following information :

(a) Captain's altimeter (0818194) read 4443 m (14,576ft) with the pressure scale set at 760 mm Hg

(b) Co-pilot's altimeter (0513164) read 4540 m (14,895 ft) with the pressure scale set at

760 mm Hg.

The above readings have been established "at the moment when power supply to the instruments was cut off probably due to the destruction of the aircraft structure."

(c) Captain's foot altimeter (0613061) was set at about 1012 Hpa.

(d) Navigator's foot altimeter (0508040) was set at 1013 Hpa.

No readings could be determined from the foot altimeters.

4.14 As can be seen, the SSRIAN report does not help in determining the actual altitude of the IL-76 aircraft at the time of collision, particularly, in view of the vast difference of 97 m (319 ft) between the two pilots' altimeters. The erratic indications could have resulted from the forces of collision besides the possible effect of highly disturbed atmospheric pressure around the pitot-static area at the moment of collision.

4.15 Because of inconclusive findings by the research institute in respect of altimeter readings, all parties have relied on FDR data and unanimously accepted flight level 140 as the altitude at which

collision occurred. We have also formed the same opinion.

4.16 What were the flight levels assigned to the two aircraft? If the flight level assigned to Saudi aircraft was 140 and to Kazak aircraft was 150 why and how Kazak aircraft descended to FL 140 ? To find answers to these questions we shall have to develop the IL-76 cockpit scenario as deducible from CVR transcript.

4.17 **ANALYSIS OF CVR TRANSCRIPT**

4.18 **Saudi aircraft** : Saudi 763 maintained its assigned FL 140 without any deviation. This fact is agreed to by all the parties before the Court. Thus having ruled out the possibility of any error on the part of Saudi pilots (one of the three main parties involved in the accident), the focus obviously shifts to the actions of Kazak Pilots/crew, weather conditions and the role of the Delhi ATC.

4.19 **Kazak Pilots/Crew.** Investigation reports from AAIB, UK and IAC, Moscow have given full details of the DFDR and CVR read-outs. These were thoroughly scrutinised. Thereafter, in order to examine the turn of events, transcripts of IL-76 CVR, B-747 CVR

and ATC tape recordings were compared. Except the intra-cockpit transmissions, these were uniform. After comparing the three, a consolidated CVR transcript was prepared covering about eight minutes before the collision. This became necessary as IAC themselves (in their report- Appendix B-2(T)) had expressed their doubts on the quality of translation of intra-cockpit Russian conversations into English by their scientists, who were not proficient enough in the English language. The text (including translation into English of Russian and Arabic words wherever occurring) was agreed to and accepted as correct by all the parties. Such text is at Appendix__D.

4.20 Two points may be noted as to this transcript. There was a slight variation in recordings of time in ATC tape and IL-76 aircraft CVR observed from beginning to end. Since these were uniform, the time indicated in IL-76 aircraft CVR was taken as reference datum. Altitudes have been noted in column 5. These notings suggest an altitude of 14886 ft having been maintained for a period of 11.5 seconds (between 13:09:27.5 and 13:09:39) and again recorded altitude of 14495 having been maintained

for a period of ten seconds (between 13:09:39.5 and 13:09:49.5). The court has not accepted the theory of Kazak aircraft having levelled out at these altitudes. The Court tends to believe that the Kazak aircraft was in the process of continuous descent. This opinion is based on AAIB's report dated 21.3.97 (Appendix C-3) which has attributed the rapid changes in altitude values to "Stickiness" of the sensor (transducer) giving input to the FDR. The said report further states that "the IL-76 aircraft was in a constant descent through 15000 ft. and may not, or may only just have levelled before the collision. This fact is also supported by the IAC report (Appendix B-3(T) which states that `sharp changes in values (upto 250 mtrs. in one second) of altitude recordings are due to wider insensitive (dead) zones of the Sensor'. Before proceeding further it may be relevant to keep in mind that after establishing contact with Delhi Area (West), the Kazak PIC in his briefing to the crew had directed that Radio Operator would act as the communications leader as the following extract from the CVR transcript shows :-

> "Well then, the alternate is Bombay, Karachi, good weather, Fuel for the alternate is for FIVE HOURS, Heading 284, Approach System is

ILS in Director Regime, Minimum 60 on 800... illegible 1800, Active at the Right, Control at the Left, Communication leads the Radioman."

4.21 The analysis of the CVR transcript leads us to the following scenario/inferences :-

(a) Radio Operator of Kazak 1907 establishes contact with Delhi Approach at 13:04:55 and is given further descent to FL 150. This clearance is acknowledged by Radio operator Navigator promptly converts the level into 4570 meters. Again, at 13:07:24 Radio Operator re-confirms with Navigator (in intra-cockpit Russian Conversation) that FL 150 was 4570 meters. Since all crew were listening out, it can safely be assumed that each crew member should have understood the descent clearance to FL 150.

(b) At 13:06:10 Saudia 763 reported on the same channel "approaching FL 100" and was cleared by ATC to climb to FL 140. Again at 13:08:50,when he reported approaching FL 140 and requested for further climb he was told to maintain FL-140 which he acknowledged. These two messages should have, at least, indicated to the Kazak pilots that Saudia aircraft was somewhere in the air and that its climb beyond FL 140 had been restricted. Pilots are always required to maintain a continuous listening watch and to be extra alert while flying in the Terminal Control Areas. It, however, appears (as would be seen a little later) that Kazak pilots paid no attention to these significant transmissions.

(c) Immediately after Saudia 763 was instructed to maintain FL 140, Radio Operator of Kazak 1907 on being asked by ATC, reported at 13:08:59 "Now reached FL 150, four six miles from Delta Papa November, radial two seven zero." As seen

from the DFDR recording, the aircraft was, at this time, only passing through 16348 feet. This incorrect reporting could be either due to casualness i.e. without reference to the instrument panel of which he did not have a clear view or because he did not understand the difference between `reached' and `approaching'. Either way, it was not acceptable. Then followed the transmission from ATC "Roger, maintain FL 150. Identified traffic 12 O'Clock, reciprocal, Saudia Boeing 747 at ten miles, likely to cross in another five miles. Report, if in sight." Radio Operator took unusually long to assimilate this message indicating difficulty in the comprehension of ATC instructions. This would not have been so, had the crew paid attention to the preceding transmission i.e. Saudia 763 being asked to maintain FL 140.

(d) Contrary to this, when Radio Operator was busy talking to ATC about the reciprocal traffic, Pilot In Command and Co-Pilot indulged in overlapping intra-cockpit conversation regarding traffic information(CVR time 12:09:28 and 12:09:29).

(e) Finally, it appears that Radio Operator did understand the implications of ATC message "Traffic (reciprocal) is at eight miles, level 140" as he acknowledged by saying "Now looking 1907." In the process, Co-pilot, busy as he was with other tasks and half attentive to ATC, grasped apparently wrong meaning thinking that he was cleared to FL 140 and he continued to descend to that level. Ironically, though probably guided by the same perception, Pilot in command did not intervene.

(f) Strangely, Navigator (who was expected to monitor altitude of the aircraft and periodically give appropriate call outs)

also did not react when the aircraft continued descending below FL 150.

(g) However, at 13:09:57 an intra-cockpit utterance "Hold the level" from one of the crew (by all accounts it could be Radio Operator, who knew and did feel that the aircraft should have stopped descent) alerted the Pilot in command who inquired at 13:09:59 (18 seconds before collision) "What level we were given?" This query completely exposed his lack of situational awareness highly unexpected of a commander.

(h) Flight Engineer added to the confusion by calling out "maintain" (ostensibly FL 140, to which the aircraft had already descended). Radio Operator, however, immediately clarified by shouting "keep the 150th, don't descend" (confirming the fact that he was simply answering the Pilot in command's earlier query and being away from the instruments, did not know the exact level of the aircraft).

(i) As observed from the tone of intra-cockpit conversation, a high level of anxiety seems to have developed in the cockpit by this time and preparations to get out of the dangerous situation began. Autopilot was switched off at 13:10:05 (11 seconds before collision) and Pilot in command asked FE to accelerate (presumably to climb).Soon after but only 4 seconds before collision, Radio Operator (probably after looking at the altimeter) shouted (in desperation) with the words "get to 150 because on the 140th uh that one uh!"and just about then the collision occurred. Both the aircraft were presumably in a cloud layer, which seems to have prevented timely visual sighting of each by the other. Switching on of VNA (Engine Heating) by IL-76 crew indicates presence of cloud.

4.22 From the foregoing narrative and crew actions, the irresistible conclusions which can safely be

drawn are as follows :-

(i) Kazak 1907 violated ATC instructions and descended below its assigned FL 150 to FL 140, which was assigned to Saudia-763. This is the direct/primary cause of collision.

(ii) The entire Kazak crew except Radio Operator took wrong meaning of "Traffic' is at eight miles, level one four zero" as the clearance for them to descend to FL 140. Such action can be attributed to their lack of working knowledge of English.

(iii) None of the Crew understood the traffic situation in the vicinity. This is borne out by their failure to link up just the preceding transmission to Saudia 763 asking him to maintain FL 140. Besides inattention, their lack of proficiency in English language is clearly borne out.

(iv) Broadly speaking each crew did not know what the others were doing. Even when known, the wrong actions were not cross checked and corrected. Hence it was a case of poorly orgnanised team, wherein each individual was on his own.

(v) Even after realising the blunder of being in a dangerous situation at least 18 seconds before collision, the Pilot in command failed to take corrective action promptly. This reflects poor leadership qualities and lack of proper crew resource management (CRM) on the part of the Pilot in command.

(vi) There is no evidence of any standard call-outs (reminder calls) made by any of the crew members of IL-76. This is contrary to the universal practice of such calls by the non flying pilot (PNF) or another designated crew member during specified phases of flight. These calls become more relevant in

cases of non availability of automated crew alerting systems such as Altitude Alert System.

(vii) Last but not the least, presence of cloud at that crucial time did prevent timely visual sighting which could have been the last straw in saving the catastrophe.

4.23 Effect of weather conditions : Whether the drop of 1000 ft (approx) in level of Kazak aircraft can be attributed to turbulence?.

4.24 The IAC Moscow has opined:

"while the elevator was being turned to reduce vertical speed and the aircraft was being brought to horizontal flight, (relative altitude 200M from collision altitude) the aircraft entered first zone of weak and then a zone of moderate turbulence. Vertical load factor in the zone of turbulence varied from 0.6 to 1.4 units and the lateral load factor from minus 0.1 to plus 0.1 units. When the aircraft was inside the cloud cover the crew switched on the engine VNA (guide vanes- Russian letters used are- BHA) heating AND then, at 13:10:0.5, switched off the automatic on -board control systems with the quick switch -off button while continuing to bring the aircraft

into horizontal flight."

4.25 AAIB has opined :

"From the recordings of acceleration on both aircraft there seemed to be an increased turbulence level for about 30 seconds before collision. This may be indicative of the aircraft entering a cloud layer."

This finding only suggests presence of cloud and, in no way, hints at any loss of altitude due to this. However, the AAIB did find indications of some stickiness in the sampling transducer because of which an attempt was made to derive altitude using two other methods:- (i) double integration of the accelerometer data and, (ii) using pitch incidence and air speed. The result of both methods for the descent from 20,000 ft until collision are shown in figure IL-76/6 (Appendix C-3(i) refers) AAIB has concluded that "the aircraft was in a constant descent through 15000 ft and may not or may only just have levelled before the collision". It thus became evident that IL-76 maintained normal (controlled) descent unaffected by the turbulence.

4.26 The Kazak side initially pleaded that it was on account of serious turbulence that the Kazak aircraft dropped by 1000 ft. At a later stage it was submitted that there were two drops of about 500 ft each (approx). The existence of such turbulence as advocated by the Kazak side does not appeal to the Court and is ruled out for the following reasons :

(a) The forecast and actual weather report from Indian Meteorological Department (IMD) (based on satellite interpretation, over the accident area and near the time of collision indicated presence of "isolated to scattered medium/high clouds over the region" with "No Echo" at 1145 and 1445 UTC. In their opinion, no turbulence was expected in the clouds herein mentioned.(Appendices E, F & G)

(b) Capt. Timothy J. Place, Commander of the USAF aircraft from Islamabad to Delhi, passing near the site of accident has deposed : "We were in the clear (VMC) when a cloud to our two o' clock position lit up. The light was orange in colour and its intensity continued to increase. We were somewhere between FL200 and FL 140 (estimate). The cloud from what I saw as it lit up was about 20-40 miles from us, about 20-30 miles in length in a line approx parallel to our path. It was approx 5000 ft from base to top with the top about even with or slightly below our altitude."

Thus the cloud was approximately 5000 ft. in thickness extending vertically from about 12000 ft. and spread horizontally about 20-30 miles. This means that it was a medium cloud, not likely to cause turbulence to such an extent that air

craft would lose as much as 1000 ft. of altitude. AAIB report also brings out turbulence activity for 30 sec. when the closure rate of both the aircraft was 1300 ft/sec. As per this, the horizontal extent of cloud works out to about 7 NM. Analysis of both these reports indicates that the cloud in question could at the most be cumulus type, which is not known to give rise to severe turbulence. Therefore, loss of altitude to the extent of 1000 ft. and that too abruptly by an IL-76 type of aircraft cannot be accepted.

(c) The Saudi aircraft which was flying at almost the same level with a longitudinal separation of only 6 to 7 miles did not report of any turbulence nor have its DFDR recordings revealed any sudden/steep variation in altitude.

(d) If indeed the cockpit crew of IL-76 had experienced moderate or severe turbulence at that crucial stage when it was descending and was about to cross another aircraft approaching reciprocally, and consequently experienced sudden/steep variation in altitude, it is inconceivable that none in the cockpit would have made some mention of it to ATC or even in intra-cockpit conversation.

(e) The DFDR recordings of IL 76 gave an impression that at times IL-76 descended as much as 391 ft. in half-a-second. If the aircraft were to actually descend at that rate i.e. about 47000 ft./min. the `g' force (approx. 44 g) would have been such that the aircraft would have certainly disintegrated. This is not supported by DFDR recordings of `g' values, which remained close to 1 g. Hence the largely varying recorded values of the altitude parameter within the same second, were the result of `stickiness' in the transducer and as such have to be ignored.

(f) RLS radar on-board IL-76 would have surely

indicated the presence/intensity of weather encountered and the crew would have been compelled to request ATC for circum-navigating the same. Nothing of this sort was done.

(g) There is no indication/evidence of passenger seat belt sign being "switched on" as is expected during flight through turbulence.

(h) AAIB's conclusion (after ignoring the reversed altitudes at DFDR time frames 738, 721,720.5, 694.5 and 692 due to `Stickiness)' that the IL-76 was in a constant descent through 15000 ft. and may not, or may only just have levelled before collision is valid. Thus, it was a case of continuous controlled descent as against abrupt loss as advocated by Kazaks. Also, IAC Moscow report does not show descent in steps. This aspect has been ignored by Kazaks.

4.27 <u>Role of Delhi ATC</u>

4.28 At the hearings the following aspects of the role of Delhi ATC were brought in issue :-

(a) Whether Vertical separation of 1000 ft assigned by ATC to the two aircraft was adequate?

(b) Were the two aircraft brought on a collision course by ATC?

(c) Why was Kazak aircraft not given timely information about Saudia Flight? Also, why was Saudia not informed about Kazak flight at all?

(d) Why was Saudia aircraft permitted to take off and not held on ground till Kazak aircraft had landed?

(e) Why did ATC not ask either or both aircraft to execute manoeuvre to take them away from each other :

(f) Why is there only a Single Corridor at Delhi for both arriving and departing flights?

(g) Non-availability of SSR at Delhi airport contributed to the accident.

(h) ATC work load was excessive.

(i) ATC Coordination was lacking.

(j) Visit to Delhi Airport ATC facilities by the team of Kazak ATC specialists.

4.29. We cannot resist observing that an accurate and complete understanding of the role of the ATC and the meaning of various terms would have avoided most of the abovementioned controversies.

4.30 Relevant extract from ICAO Annex 11 is reproduced below :-

<u>2.2 Objectives of Air Traffic Services</u>

The objectives of air traffic services shall be to

(a) Prevent collisions between aircraft;

(b) Prevent collisions between aircraft in the manoeuvring area and obstructions in that area;

(c) Expedite and maintain an orderly flow of air traffic;

(d) Provide advice and information useful for the safe and efficient conduct of flights;

(e) Notify appropriate organisations regarding aircraft in need of search and rescue aid, and assist such organisations as required.

4.31. Among others, ICAO Doc 4444 (Rules of the Air and Air Traffic Services) contains the provisions governing the procedures aimed to achieve the objectives of ATS as mentioned above. The correct position regarding separation is laid down in Doc 4444. Doc 9426 (ATS Planning Manual) is another important document pertaining to ATS.

4.32 **SEPARATION MINIMA** ICAO Doc 4444, Part III, Para 1.1 (Page 3-1) (13th Edn-1996) which applies to Area and Approach Control Service, clearly states that `vertical or horizontal separation' shall be provided in the cases cited therein, which includes between IFR flights in Class D air space, in which

the two aircraft were in the present case. Para 3.1 further stipulates that the vertical separation minima shall be, in the present case, a nominal 1000 ft., being below FL 290. This standard separation has been approved by ICAO after taking into account possible errors and tolerances. This is being practiced all across the globe. As for the clearance, it has been in accordance with DOC 4444, Part-III, Section 10. Doc 4444 specifically cautions against application of excessive separation as it would negate the very objective of expediting traffic. Neither any provisions of ICAO Annexes/Docs nor under any common practice was it required in the present case to provide a larger separation and it is clear from Para 5.7, Part III, Doc 4444 that, even under severe turbulence conditions, a vertical separation of 1000 ft. was adequate.

4.32.1 Radar services in Air Traffic Management contemplate only horizontal separation between aircraft. Such horizontal separation may be either lateral separation or longitudinal separation. Vertical separation is not a part of separation under radar services but is procedural separation. Even when Primary and Secondary radar/ MSSR are installed,

radar separation would still be only horizontal separation, though with MSSR facility it would be possible for the radar controller to know the altitude of the aircraft as an additional input so as to plan the separation as well as manage the flow of traffic. Thus when horizontal separation is provided under radar services, vertical separation is not additionally necessary, and vice versa, when vertical separation is provided horizontal separation is not additionally necessary.

4.32.2 In relation to separation minima, India has not filed any differences with ICAO as regards the provisions contained in ICAO Doc 4444. The vertical separation of 1000 ft. provided in this case was in conformity with ICAO standards and was sufficient to ensure safe, efficient and smooth flow of air traffic.

4.33. Collision Course. If two aircraft are maintaining same level and are on converging tracks, only then these could be called as being on collision course. In the instant case, since vertical separation of 1000 feet had been catered for, the two aircraft were not on a collision course, though they were on a reciprocal course. Furthermore, both these

aircraft had confirmed on RT as to be maintaining FL 140 and FL 150 respectively as assigned to them and thus were expected to be in level flight at the time of the planned crossing. It may be borne in mind that, while in level flight, aircraft all over the world are flying with the standard separations as specified by ICAO along the same route, in the same and reciprocal directions.

4.34. Traffic Information. It was argued by some parties that the traffic information provided by the Controller was late, inadequate and incorrect. In order to understand this issue, we need to refer to Doc 4444, part III, Section 14.1 which States "Essential traffic is that controlled traffic to which the provision of separation by ATC is applicable, but which in relation to a particular controlled flight, is not separated therefrom by the minima set forth in Section 2 to 9 inclusive of Part III, Section 3 of Part-IV and Section 6.6. of Part VI. Since in this case, both the aircraft were instructed to maintain flight levels which were separated as per Section 3.1 (b) there was no essential traffic as such, nor there was any collision hazard expected (as per Section 8.2 of Part-III

information to either of the two was not necessary.

4.34.1 Traffic information in this case to Kazak 1907 was given only as an additional (not essential) input necessitated in the light of the background of experience about the frequent inability of the CIS crew to properly understand the instructions given in English. It may be borne in mind that this information was given only after asking Kazak 1907 to maintain FL 150. Furthermore, this information was given immediately after identifying Kazak 1907 on radar and in the same transmission which started at 13:09:08. This communication lasted till 13:09:41 (until it was understood by Radio Operator). Prior to this stage, when the aircraft was being cleared for continuous descent, this information was not even relevant.

4.34.2 A feeble grievance was made by the Saudi Airlines as also by the Kazakstan Airlines that, whereas the controller informed the IL-76 of the reciprocal traffic at FL 140, similar information was not supplied to the Saudi aircraft. As explained earlier in Para 4.32 passing of the traffic information by ATC to either of the two aircraft was

neither required nor warranted. Thus, denial of the same to Saudi aircraft cannot be questioned, whereas passing of the same to Kazak 1907 can at least be appreciated when viewed in the light of para 1.3.4 (Part II Section 3 Chapterl of Doc 9426) which, inter alia, states "air traffic descending for approach normally requires more attention from the controller than other flight phases". Further, there is nothing to suggest as per the laid down provisions that in such cases parity had to be maintained. In any case each aircraft is expected to listen to all transmissions on the working frequency.

4.34.3 The Controller's actions in the instant case were appropriate and as laid down in Doc 4444.

4.35. Why was Saudia 763 not held on ground till Kazak 1907 landed ? One of the basic objectives of ATS is to expedite and maintain an orderly flow of traffic. To achieve this, as per the provisions laid down, a departing aircraft is not held back unless there is an arriving aircraft within about 4-6 NMs away on the final approach. When the Saudi aircraft took off, the IL-76 was about 60 NMs from Delhi airport.

4.35.1. If the contention that Saudi aircraft should have been held back on the ground until the Kazak aircraft had landed were to be accepted, neither Delhi airport would be able to handle about 20 movements per hour nor would London Heathrow be able to handle over 80 movements per hour. The suggestion, not being practicable does not find acceptance..

4.36 <u>WHY DID ATC NOT ASK EITHER OR BOTH THE AIRCRAFT TO EXECUTE MANOEUVERS TO TAKE THEM AWAY FROM EACH OTHER</u> ? Para 10.1.3 (Part ii of Doc 4444) brings out that ATC clearances are based on known traffic conditions which affect safety in aircraft operation. Further, para 10.2.2, inter alia states "aircraft arriving and/or departing within a terminal control area shall, where possible, be cleared by the most direct route from the point of entry to the aerodrome of landing or from the aerodrome of departure to the point of exit. In the instant case, both the aircraft had been assigned different levels (with standard separation) and both had confirmed that they were maintaining assigned levels. Under the circumstances controller's actions were in conformity with the above mentioned provisions and

there seemed to be no basis to issue any instructions to the aircraft other than maintain their levels.

4.37. SINGLE CORRIDOR `Single corridors' for entry and exit exist at many international airports. Entry and exit of aircraft through a `single corridor', when under radar control with provision of applicable separation minima, do offer adequate safety, provided the aircraft adhere to the ATC clearances. Different or larger separation minima have not been laid down or even recommended by ICAO for `single corridor' traffic or for reciprocal traffic.

4.37.1 Laterally separated uni-directional entry and exit routes are evolved primarily to optimise the airspace capacity utilisation to meet the increasing demands and for ensuring smooth flow of traffic. To that extent it enhances safety and reduces controller's work load by application of SIDs and STARs. However, even in such cases, if an aircraft violates the assigned course and strays to the left or right, a potential collision situation will ensue. Laterally separated entry and exit routes,

or larger vertical separation, are no substitute for good airmanship. Notwithstanding the above contention, uni-directional routes are desirable and should be established wherever possible.

4.37.2. While uni-directional routes provide for in-built lateral separation the traffic on bi- directional (single corridor) routes has to be longitudinally or vertically separated. In the instant case, since both the flights had been assigned levels separated vertically by 1000 ft, use of single corridor cannot be accepted as a contributory factor.

4.37.3 It was brought out by AAI counsel that re-structuring of certain routes (including G452, the route on which the mid-air collision occurred) in Delhi TMA is already on the anvil as part of the ATC modernisation project. Having visited Heathrow Airport and associated London Area and Terminal Control Centre the Court is of the opinion that there is an urgent need to emulate the NATS (National Air Traffic Services) model at least in the matter of increasing the traffic handling capacity at Indian airports which is regrettably low.

4.38. <u>Secondary Surveillance Radar (SSR)</u>. It was contended

on behalf of the Kazak Republic and Airlines as also the Saudi Airlines that Delhi Airport lacked the modern secondary radar. The contention, that if only such a modern radar system were available the accident might not have occurred, is not correct.

4.38.1 In this regard, it may be relevant to refer to Part I, Section 2, Chapter 9 of Doc 9426 on Advanced ATS Systems comprising of Primary Surveillance Radar, Secondary Surveillance Radar and Electronic Data Processing Equipment. The position regarding their requirements is summed up in the following Paras :-

> 9.1.1 "Apart from adequate and reliable ground - ground and air-ground communications, an ATC Unit applying conventional control methods has comparatively few requirements for additional means and equipment. Experience has shown that if controllers received adequate training and the social and working conditions are reasonably satisfactory, an ATC unit will be able to handle appreciable amounts of air traffic before it would be necessary to introduce advanced ATS systems."
>
> 9.1.2 While sophisticated equipment will, as a general rule, assist in resolving a particularly pressing problem (primarily capacity limitations), it is also likely that its use will create a number of new problems which, while probably of a less urgent nature, will nevertheless require resolution before the full

benefit of the new equipment can be obtained. It has also been found that the introduction of such new equipment does not immediately reduce manpower requirements. In many cases, cost savings on the manpower side, when compared with the increase in air traffic, can only be made once the equipment is used close to its full inherent capacity.

4.38.2 Sophisticated equipment like SSR can, as a general rule, assist in resolving a particularly pressing problem (primarily of capacity limitations) but can not by itself guarantee total safety. The availability of an SSR equipment could not prevent a mid-air collision between a British Airways Trident and a DC-9 of INEX ADRIA in Yugoslav airspace over Zagreb on 10th September, 1976. Nevertheless, such an aid is useful but not a mandatory requirement. The decision on its installation rests with individual state(s) without any say in the matter by other states.

4.38.3 What really matters is whether availability of such systems or otherwise is known so as to facilitate flight planning. Since the availability of navigational aids, radar systems and other facilities at Delhi Airport forms part of the

published information, it was known to both Kazak and Saudi crew who should have planned their flights accordingly. They knew in advance that SSR was not available at Delhi. Merely because availability of better aids could possibly have averted the accident, non-availability of such aids, if not mandatory, cannot be considered a circumstance contributing to the accident.

4.38.4 Notwithstanding the above, faced with traffic handling limitations due to age-old equipment, India is already in the process of modernising her ATC system at Delhi, Bombay and some other major airports. As brought out by AAI counsel, whereas MSSRs (Westing house Make) have already become functional at Trivandrum, Hyderabad, Gauhati (with Ahmedabad, Calcutta and Madras to follow) fully automated primary/secondary radars (Raytheon Make) are under installation at Delhi and Bombay. Although these turnkey projects were conceived nearly a decade ago; as these require detailed planning in terms of resources the lead time is considerably long. The arguments advanced by Kazak side that India woke up only after the mid air collision are unfounded. Nevertheless, the accident has drawn,

attention to the need to hasten the commissioning of the systems which the Indian Government needs to consider with all sincerity.

4.39. ATC workload. Saudi counsel contended that Radar Controller on the day of the accident was over worked and this factor might have contributed to the accident. This argument was denied by AAI counsel. Notwithstanding the arguments, the Court had already carried out a thorough examination of various transcripts (ATC tape and inter-com) and come to the following conclusions :-

(a) The workload of Radar Controller was definitely excessive. This was due to the fact that traffic intensity was high and only one Controller handled both arriving and departing flights. The system of sectorised controlling was not yet in vogue due to certain constraints like manpower as well as equipment.

(b) Despite (a) above, the Radar Controller handled the traffic situation very confidently and efficiently. It goes to his credit that even after the accident, he remained alert and composed and continued controlling effectively

till relieved. Thus, at least on the day of reckoning, there is nothing to indicate that the over-work in any way contributed to the accident.

4.40. ATS Coordination. While referring to the transcript containing intercom conversation between Area Control (West) and Approach/Radar it was contended by the Kazak side that the 'Controllers did not properly coordinate their actions'. This contention is based on the premise that both the aircraft which were expected to cross' each other at about 80 NM. from Delhi, actually collided at about 40 NM.

4.40.1 The plea, to say the least, is based on ignorance of aviation realities. In the air, actual traffic situation is constantly changing, therefore the actual crossing may not occur at the anticipated distance and time. This anticipation by ATC was, in fact, one of the steps towards advance planning and coordination.

4.40.2 Having scrutinised the transcripts we do not find any indication of lack of proper coordination on the part of Delhi ATC.

4.41 We are very clear in our mind that though ATC Delhi is overloaded with work and there is ample scope for

improvement. This did not contribute to the accident. Finding such faults with ATC has nothing to do with the cause and circumstances of this accident.

4.42 Visit to Delhi ATC by Kazak ATC specialists :- Counsel for Kazak Republic and Airlines made a request for a visit to Delhi Airport by Kazak ATC specialists for the purpose of inspection of ATS facilities/procedures in vogue thereat. This was objected to by AAI counsel. Though the request for inspection by parties was not in order yet, to ensure transparency, the parties desirous of doing so were allowed to visit ATS `facilities. Kazak Specialists, after their visit to Delhi ATC, basically commented on three aspects, namely (i) the typewritten instruction on page 8 of ASRI Manual, (ii) Procedure regarding investigation of airmisses and (iii) the state of primary radar at Delhi Airport.

4.42.1 The `typewritten instruction' reference was as follows :

> " 12. Radar separation based on primary radar shall be so applied that the distance between the centers of radar blips representing the locations of the aircraft concerned is never less than 5 NM (nautical miles).

The team noticed that at the end of this instruction

the following handwritten words had been added but were neither signed nor dated.

"Unless vertical separation exists."

4.42.2 In their affidavit the Kazak side also stated :

> " Although the ASRI Manual provision with the handwritten notation added does not violate ICAO standards, in our opinion, the handwritten notation was an inappropriate addition in light of all the circumstances existing at the Delhi airport."

4.42.3 On being asked to explain, the AAI has stated through its counsel that text of the instructions as circulated was typewritten; the hand written words were not there. Some one unidentified and not ascertained has made unauthorised noting of these words. The addition is neither initialled nor authenticated by any one. It has to be ignored.

4.42.4 The court feels that it is all making mountain of a mole hill. The handwritten words do not form part of authentic text. They have to be ignored. They are superfluous.

4.42.5 The air- misses were already being investigated by higher authorities viz AAI and DGCA. This is in accordance with recognised procedures. However, presently there is no system of dissemination of the outcome of the investigations to the

controllers. This needs to be introduced.

4.42.6 Lastly, the primary radar though old was serviceable on 12.11.96 and necessary calibrations had been carried out in the past as warranted. AAI is aware of the situation and modernisation of ATS systems is already in progress.

CHAPTER IV-2

INCIDENTAL ISSUES

4.43 In order to appreciate the causes and circumstances leading to the accident, the court made efforts to familiarise with and study the cockpit layouts of Boeing 747 and IL-76. Lot of dis-similarities were observed in the two layouts. Boeing cockpit certainly presented a higher degree of sophistication in comparison to IL-76. This aspect also got highlighted in the analysis reports of the two investigating agencies, AAIB and IAC specially with regard to the determination of the actual altitude at the time of collision. It is proposed to deal with two important issues which need attention of the ICAO and the member States.

4.44 Tolerance Values in Altitude Recordings in FDR of IL-76

IAC Moscow initially opined that the tolerance values in the altitude recordings in FDR of ill fated IL-76 were to the tune of ±3%. In the supplementary report however they concluded that the margin could be -200/ +100 meters of the recorded altitude of 4300 meters at the time of collision. As against this, AAIB concluded that in the case of IL-76, the tolerance values in the

recorded altitude of 14100 ft (at the time of collision) could at best, be ± 500 ft. The variations were thus quite revealing. What is significant, in this case is that the maximum tolerance of ± 200 meters as laid down in Annexure 6 (Table Parameters for Flight Data recorded , Para 2) had been reached only at an altitude of 4300 meters. What would have happened if the altiutude of the aircraft were much higher. The Court, therefore, opines that the technical specifications of the DFR fitted in the ill-fated IL-76 were not in conformity with the standards laid down by ICAO.

4.45 ON BOARD AVOINOICS :- Modern technology has resulted in reduced pilot workload termendously and enhanced air safety. Advanced versions of Boeing, Airbus and some other similar type of modern day aircraft provide good examples. There is however a long way to go for many other types to catch up with these . Notwithstanding this , if air safety is a concern and the aim, there is an urgent need to think in terms of certain vital on board avionics like Airborne collision Avoidance System (ACAS) also termed as Traffic Collision Avoidance System (TCAS) and Altitude Alert/Altitude Acquisition System. Though not made mandatory by ICAO so far the necessity of such aids is strongly felt. In the instant

case, had the IL-76 aircraft been equipped with the latter, the chances of avoidance of collision would have been greatly increased provided of course the language barrier did not exist and the pilot selected the appropriate level as instructed by ATC. It is understood that whereas availability of these aids on public transport aircraft is already made mandatory in the US airspace, European countries have also announced similar intentions. Further DGCA (India) has made its applicability mandatory with effect from 1.1.1999. Under the circumstances it is for consideration of the ICAO whether such steps could be universally globalised. The flying environment which is becoming congested day by day will surely become safer with the adoption of such measures.

4.46 During the course of proceedings the court had an opportunity of studying ATS in Moscow and London and compare the same with those in India. The court also gathered information about organisational set up of aviation institutions/establishments/functionaries in India and their problems, difficulties and shortcomings. Though unconnected with the accident under inquiry, the Court has gone into these matters as they are ultimately associated with aviation safety in

general.

4.47 In the field of aviation, flying and (air traffic) controlling are the two most important aspects and the other support services must take only a second place. it is, therefore, necessary that both these activities- being complementary to each other- are offered adequate opportunities to grow side by side to rise to the occasion. In the case of civil aviation, it is seen that whereas the government's responsibility towards provision of Air Traffic Services is total, its role towards flying is limited to performance of regulatory functions; the investment in aircraft being left to the operators (various airlines) With all good intentions the Indian Govt adopted open sky policy but the same has remained lopsided in the sense that it resulted in mushrooming of airlines thereby bringing about tremendous increase in air traffic without matching additions to the ATC infrastructure. This has landed us in an unhealthy situation. The reasons are not difficult to find. Unfortunately in our country ATC is being treated like any other service and its true significance is not being recognised. Accordingly, its development has been far from satisfactory. The Court has formed this opinion by comparing it with that existing in UK, Russia and USA, Whereas India may not succeed in

achieving similar standards (for want of resources) as prevalent in these countries,. there is no harm in borrowing their concepts and learning from their experiences. There is no denying the fact that for the proper growth of civil aviation in the country, the ATC has to be given a special place in the scheme of things or else the country will continue to lag behind. India needs to aim to achieve the traffic handling capacity of over 80 movements per hour (which prevails at Heathrow) as against Delhi's present rate of about 12-15 movements (likely to go up to about 30-35 even after commissioning of Raytheon system). In this Chapter the Court has also made an effort to draw the attention of the Govt of India towards the inadequacies in the field of ATC. The Govt would be well advised to take due notice of these shortcomings and endeavour to make up the deficiencies.

4.48 The Court proposes to place on record its view point and observations on the following aspects related to provision of Air Traffic Services in India and related matters.

4.49 <u>Organisational Set-up</u>

4.49.1 Till early 70s DGCA had been the only government agency charged with the responsibility of promotion of civil aviation in the country including provision of Air

Traffic services in the Indian air space. In 1973, part of this responsibility was transferred to International Airports Authority of India, a new organisation created to look after the infrastructure mainly at four international airports but provision of ATS remained with the DGCA. In 1986, National Airports Authority was born, which was handed over the control of all domestic airports along with the responsibility of providing Air Traffic Services including control of Indian air space. Lastly with effect from 1.4.95 the latter two agencies have merged into one to form Airports Authority of India (AAI) with national and international divisions.

4.49.2 It is thus evident that in the organizational set up of civil aviation, changes have been too frequent and the Govt have not been able to evolve a long term aviation policy which is badly needed for proper growth of the aviation industry in the country. Further as far as ATC is concerned, DGCA's role has become quite limited and the entire responsibility stands transferred to AAI, an autonomous body. Ironically, DGCA does not even have any ATC element on its strength and is thus seriously constrained in overseeing the ATC functions of AAI. This arrangement does not appear to

be in consonance with the obligation of meeting statutory requirement of the country as a contracting State of ICAO. In this regard, reference may be had to Part IV Section 1 Chapter 1 of the ICAO DOC 9426 (Organisation of Air Traffic Services). Paras 1.2.1 AND 1.2.2 read as follows:

> 1.2.1. A civil aviation administration is charged with the responsibility for promoting and supervising the development of civil aviation in the State concerned while, at the same time, fostering safety, achieving the efficient use of navigable airspace, and developing and operating a satisfactory air navigation system.
>
> 1.2.2. The director of civil aviation issues and enforces rules, regulations and minimum Standards relating to the operation of aircraft, the licensing and rating of personnel including the supervision and enforcement of medical standards, the operations specifications for commercial air operations, the surveillance of air operations, the operation of the air navigation system and the provision of ATS.

4.49.3 Accepting that AAI has now been made responsible for the provision, promotion and efficiency of ATS it is considered desirable to examine its organisational set up with regard to ATC. In this organisation, the highest post which an ATC professional can fill up is that of Executive Director (Air Traffic Management) who is placed under Member (Operations) who in turn reports to the Chairman, the Head of the Organisation.

Interestingly, Member (Operations) need not be an ATC professional. Thus, operationally ED (ATM) does not even have direct access to the Chairman which is quite necessary. Thus in the hierarchical set up, this important limb (it may be proper to term it as the most important operational element) is not adequately represented.

4.49.4 Reference may be had to Part III Section 1 Chapter 1 of ICAO DOC 9426- Organisation of Air Traffic Services . Paras 1.1.3 and 1.1.4 read as follows :

> 1.1.3 It is generally accepted that in the organisation of the ATS, there will be a section of the Central or Headquarters administration responsible for the over-all policy, planning, personnel and budgetary management of ATS. This Section should have a high enough ranking in the Government hierarchy to assure that an equitable share of the total resources available are assigned to ATS (i.e. money and people) and that the importance of the role of ATS in the determination of the overall priorities and policies of the administration is recognised.
>
> 1.1.4 A regional organization may be a part of the ATS structure, although operating semi-independently in the provision of day-to-day service. Such a delegation of functional responsibility to the field by Headquarters allows individual ATS units to be grouped under a common regional management. These units may comprise Area Control Centres (ACCs), approach Control Offices (APPs) and aerodrome control towers, and their task is to provide ATS at the operational level and

within a geographical region.

4.49.5 It thus follows that ATC should not only be well represented at HQ level but also be in a commanding position at the regional level and downwards. Unfortunately, it is not so in the existing organisational set up of AAI. It may be relevant to point out here that ATCCs (Comprising ACCs, FICs and RCCs) are purely ATS units which need to be headed by ATS professionals. Placing these units under technical heads who are, in fact, required to provide and maintain necessary equipment/ infrastructure to support ATC is bound to lead to deterioration in maintenance standards and delays in the installation of new facilities. For effective and efficient functioning of ATS the user (ATC) must not be subordinated to the provider or else there will be compromises. In UK and Russia, where the court was able to visit London ATCC and Moscow ATCC respectively the aspect highlighted above is well taken care of. There is therefore a strong need to have a re-look at the system in India and re-organise the same to accord proper recognition to ATC. Creating an independent ATS organisation

on the pattern of NATS in UK could be the answer.

4.50 COORDINATION WITH THE MILITARY

4.50.1 The court made efforts to compare ATC system in India with those prevailing in advanced countries like UK, USA and Russia. Whereas visits to London and Moscow ATCC provided a direct insight into their working and systems, knowledge about USA is obtained from ICAO DOC 9426.

4.50.2 Before proceeding further it may be relevant to comment on the important aspect of civil/military coordination in aviation as it exists in India. There are two major users of the airspace (to be rightly termed as national resource) viz AAI and IAF. Both of these independently provide ATS within their assigned areas of jurisdiction and have gone ahead in creating necessary infrastructure guided by their own considerations. In most of the cases the facilities have been duplicated and their uses are often denied by one to the other party. It is a pity that both the organisations have been working in water-tight compartments; one trying to establish supremacy over the other. This lacuna

had been highlighted by Tata Committee, which was appointed to review the civil aviation set-up in the country subsequent to a Boeing crash at Palam in 1971 wherein it was strongly recommended that the country should adopt an integrated civil/military ATC set up on the pattern of NATS as prevalent in UK. Even after lapse of nearly 25 years, India is yet to make any headway in this direction. In fact , in spite of the national awakening leading to establishment of an Expert Group to adopt an integrated approach,. it was painful to observe that in the new ATC complex, the IAF element has still been kept totally isolated. In fact, in the present set up there is no IAF ATC element co-located alongside ACCS/FICs except at Delhi where though a small liaison cell exists but is not performing any ATC functions.

4.50.3 The IAF air defence units (MLUs) co-located with ACCS/FICs have altogether a different role to perform and cannot do justice as far as ATC coordination is concerned. Further, IAF at present having nearly 50 per cent of national airspace under its control is reluctant to part with

it for the growth of civil aviation.

4.50.4 Such lacunae clearly point towards lack of desired civil/military coordination. Reference may be had to Part II Section 1 Chapter 2 of ICAO DOC 9426 on Coordination with Military (relevant paras reproduced below)

> 2.2.1. Rapid changes in the sophistication and the performance characteristics of both civil and military aircraft in the early 1950s, accompanied by the construction of major civil and military airfields, and the organization of the airspace into a network of airways, terminal areas and control zones, resulted in more or less significant restrictions on the freedom of movement by military aircraft. On the one hand, the civil operators demanded safeguard of their aircraft by the rigid application of separation standards whilst the military authorities required the fullest amount of tactical freedom and flexibility in the conduct of their flight operations.
>
> 2.2.3 Considerable differences exist in regard to the role which military aviation is required to play in any particular State. The methods by which civil-military coordination is accomplished in respective ATS organizations is left to the determination of the individual States. However, in order to understand the problem, it is necessary to consider the civil requirements for airspace in all three dimensions and relate these requirements to the environment in which the military need to conduct their operations. The resultant sharing of the airspace must therefore be made in such a manner that military operations do not constitute a hazard to the safe conduct of

civil flights. A national co-ordinating organisation is often established to meet these sometimes opposing objectives.

2.2.5 The task of a co-ordinating committee is to develop national ATS rules and procedures for approval and implementation by the respective civil and military authorities. The manner of achieving such rules and procedures is suggested by the following guidelines :

a) procedures should, whenever possible conform to the civil aviation rules and regulations developed by ICAO or the State concerned;

b) aeronautical facilities and ground services required for civil or military use should be provided jointly or on a common, integrated basis;

c) personnel in civil and military ATS units should be required to meet equal standards in training and rating, based on applicable ICAO provisions;

d) neither the military nor the civil authority should unilaterally establish controlled and/or reserved or restricted airspace;

e) duplication of effort in research and development as well as in practical operations should be avoided and ground facilities, equipment and services should be shared whenever practical.

2.2.7 The practical application on civil/military co-ordination is based on the philosophy that the greatest degree of safety and efficiency in the utilisation of airspace is achieved when civil and military air traffic are integrated in a common system, and all aircraft within national airspace are subject to common rules of the air and ATC procedures. However, it must be recognised that there will be occasions when civil and military requirements are

incompatible and special airspace arrangements are necessary. Depending on the significance of either the civil or the military requirements, practical co-ordination can range from simple arrangements to circumstances whereby significant and sophisticated military requirements must be accommodated.

2.2.8. In some States, it is common practice for military personnel to be attached to civil ATC units where they are employed in both operational and procedural positions and are also involved in areas such as research and development and airways planning. As all ATC procedures must per se be fully co-ordinated with the military authorities before adoption, the involvement of military personnel in the activities, as both users and providers is essential.

4.50.5 SYSTEM IN MOSCOW ATCC. The Centre is located away from the Moscow airport and houses Area Control, Approach Control and Flow Control Centres besides a Simulator with large scale training capacity. The entrance to the Area Control Centre is conspicuous by way of large number of workstations which are manned by Air Force Air Traffic and Air Defence Controllers. Just adjacent to that, there are other work stations, which are manned by civil controllers. The co-locations of civil and military controllers without any barriers provides a good degree of coordination between the two. The Centre is headed by an ATC Professional with the designation of a Director.

4.50.6 SYSTEM IN UK (LONDON) ATCC. The Court was highly impressed with the system prevailing in London ATCC at West Drayton. The center comprised of two main wings, one manned exclusively by the military (RAF) Controllers, and the other, manned jointly by civil and military controllers working side by side. Whereas civil wing provided services in and exercised jurisdiction over controlled airspace, the military wing did so in respect of uncontrolled airspace irrespective of the traffic flying therein. In addition the military wing (Distress centre) was responsible for search and rescue of both civil and military traffic in the entire airspace of the country. By and large the resources (equipment) being made use of were common. The system appeared to be one of the best examples of civil/military coordination. The centre is headed by an ATC professional with the designation of a Director. Smooth and efficient functioning of ATC was the hallmark of NATS.

4.50.7 Further the situation pertaining to this aspect in USA is summed up in Appendix-A [Civil/Military coordination of ATC in USA] of part II

Section 1 Chapter 2, of DOC 9426 (Paras 1,2 and 10 reproduced)

"1 As early as 1945 in the United States, a policy for the development of a civil/military ATC system along common lines was determined and resulted in the formation of the Air Coordinating Committee with the object of achieving an integrated and coordinated federal aviation policy.

2. The need for common system was expressed in the following excerpts from Air Coordinating Committees civil Air Policy :

The national interest dictates that a single, integrated system of air navigation and traffic control be developed and maintained so as to permit the efficiency in the use of modern aircraft capabilities required for defence, economy and the safety of persons and property.

The single air navigation and traffic control must :

(a) satisfy the basic requirements of all civil and military operations (excluding special military needs peculiar to airwar fare);

(b) assure safe and reliable operation under all prevalent conditions;

(c) be capable of immediate integration of air defence system of the United States.

There is a need to provide for safety and efficiency in civil operations while simultaneously meeting military demand for mobility, flexibility, speed of operational handling and a system capable of integration within the continental air defence network. It shall be the continuing policy of the United States to

(a) provide for a single national common civil, military system of air navigation and air traffic control. The national integrated system shall satisfy the air navigation and air traffic control requirements of all civil and military air operations, except for those special military requirements peculiar to air warfare;

(b) provide a common system that shall be capable of immediate integration with air defence system of the United States and will constitute and auxiliary to the air defence network;

(c) provide for an accelerated joint civil/military programme of research and development to keep the system abreast of current and forceable future operational requirements;

(d) accelerate the transition to the most advanced concept of this common system.

10 Through cooperation of civil and military authorities, approx. 85 per cent of country's airspace (over land) has been designated joint user airspace. In joint use airspace, ATC may authorise operations, thus making this airspace available to other users at times when its reservation for the designated military use is not necessary. "

4.50.8 It is felt that the prevalent ATC systems in the abovementioned advanced countries have stood the test of time and India needs to go in for an integrated approach without further loss of time. Had it been done that earlier, the civil ATC at Palam could have advantageously used the SSR facility located in the close proximity at Air

Force Station Arjangarh, thereby affording an opportunity to the controller to alert the erring pilot for a possible corrective action in this accident. There is no denying the fact that an integrated set up will surely be economical due to avoidance of duplication of resources and will also promote efficiency and air safety by way of optimum use of air space; hence the same would be very much in national interest.

4.51. PECULIAR ROLE OF ATC

4.51.1 Prompted by media reports making adverse comments on ATC profession and a strike threat on 28.3.97 by ATC Guild of India followed by actual strike on 3.4.97 paralysing the entire domestic/international flights, the Court made efforts to get at the causes leading to such situations. It is felt that the profession does not enjoy due recognition and the respect it deserves. This is probably the root cause which is leading to discontentment among the air traffic controllers. The ATC job in present day environment is highly specialised and complex and demands utmost dedication. The personnel employed on these duties, therefore, need special consideration in all

respects. It goes without saying that whereas the responsibility of a pilot-in-command is limited to the safety of his aircraft and passengers on board thereon, that of the controller extends to all the aircraft (and passengers) under his control at any given time. Reference may be made to Part-IV Section 1 Chapter 2 of ICAO Doc 9426-ATC's Role in the Civil Service (relevant paras reproduced below)--

> 2.4.2.1 It is generally recognised that ATS does not easily fit into the civil service because of its involvement in public safety and the essentiality of ATS in respect of public air transport. As a result, ATS personnel have found that their industrial bargaining position is different from that of most other civil services. To avoid constant confrontation, ATS management and employee committees should be formed so that problems can be aired as they arise. Access by employee representatives to senior management should not only be accepted but should be actively encouraged when safety is claimed to be the basis of unrest.

> 2.4.2.2 It is usual for government organizations to have a standard code for personnel conditions which include the working area per person, furniture, floor coverings and other similar items. Such a code does not usually satisfy the ATS working requirements. Administrative action is therefore necessary to exempt ATS planners from adhering to standard codes where the operational requirement can justify specialised treatment. Areas of obvious conflict arise in the design of public offices vis-a-vis ATC operational rooms such as the need for the latter to have a higher ceiling height, special lighting, special

acoustic treatment such as noise absorbent floors and ceilings, and the need for more efficient ventilation, heating and cooling than usual. To avoid such conflict, consideration should be given to consulting working environment specialists in those cases where the environment has an influence on the operating capacity of personnel concerned (i.e. use of radar and/or video displays).

2.4.2.3. Because it is usually very difficult for ATS personnel to transfer to, or gain promotion in other disciplines of the civil service, controllers tend to group together in specialised associations and seek affiliation on an international scale. Experience indicates that the civil service and management should not object to such affiliations to ensure industrial harmony. On the whole, ATS personnel are singularly dedicated to their task and a State may have much to gain from the knowledge which flows from international communication. From time to time administrations may therefore be confronted with requests to support participation by elected ATS representatives at safety symposia dealing with ATS matters. In general terms, the administration may be well advised to give favorable consideration and limited support to justified requests, on an ad hoc basis, in order to preserve good labour relations and offer educational opportunities to its ATS personnel.

2.4.3. **International aspects of service conditions** Known differences in the industrial legislation in neighboring States often make it likely that the terms and conditions of employment will also differ considerably for ATS personnel performing identical duties. In the course of familiarisation visits between units, it is inevitable that these matters will be discussed, which may give rise to industrial unrest. However, in the formulation of terms and conditions of service there are many considerations to be taken into account before any realistic conclusions can

be drawn, e.g. the cost of living factor may vary considerably between neighbouring States. ATS personnel have shown themselves to be very aware of their industrial surroundings. Therefore ATS management should take steps to keep abreast of conditions and significant changes in conditions in adjoining States and with the assistance of qualified industrial and economic advisers, endeavor to quantify the variations in employment conditions and keep their staff fully informed.

4.51.2 From the foregoing, it is thus evident that ATC is a unique job and its comparison with any other is uncalled for. It needs an identity of its own. Once that is accepted in principle, the disputes arising between the ATC Guild (India) and the authorities (Govt/AAI) could be amicably settled. In this regard, the Court is inclined to suggest de-linking of ATS from the normal organisational set-up and create an independent ATS structure to be governed by altogether different terms and conditions.

4.52 **WORKING ENVIRONMENT AT DELHI ATC** :

4.52.1 Relevant information on this aspect has already been complied and kept separately in the records. DGCA/AAI would do well to peruse the same.

4.52.2 In the present complex whereas there was no radar

equipment in the Area Control Centre (Air Route Surveillance Radar had been withdrawn w.e.f. 2nd February, 1996), the approach controller relied only on an age-old /outdated Airport Surveillance Radar (ASR) with a limited range of about 60 NM. The latter being first generation radar imposes severe strain on the controller's eyes. Availability and state of maintenance of other equipment also were not upto the desired standard. All this combined with cramped layout of various control positions presented an unhealthy working environment. Dialogue with some of the controllers on duty indicated that the working relationship between ATC and communications was not conducive to smooth functioning of ATC. The modernisation of ATC had taken too long to materialise. This could be attributed to the fact that because of the existing organisational structure, ATC personnel did not have proper say in the matter. It was painful to note that in the process of acquisition of SSR, civil aviation, which should have, in fact, taken the lead, was lagging behind even the IAF by at least a decade.

4.52.3 Inadequacy of proper equipment adversely affect-

ed traffic handling capacity of ATC, which was, in addition, plagued due to shortage of man-power. At any given time. there was only one radar controller performing the functions of approach controller; this leads to overwork and undue fatigue.

4.52.4 A look at the new ATC complex is to some extent, a matter of satisfaction in the sense that current generation radar (both SSR and PSR) good communications network and automation will provide a quantum jump towards improvement of controlling techniques, thereby leading to about two to three times increase in traffic handling capacity. This would, however, be possible only if the ATC manpower (officer cadre) is adequately augmented so as to change over to sectorisation method of controlling.

4.52.5 In the new complex there is also a need to reorganise the working space as some of the operational activities like ATC simulator, co-location of approach and area control leading to congestion and increased noise level and IAF elements definitely need to ease out. Further it is felt that

in view of the ensuing increase in air traffic due to open sky policy of the Govt, a few more work stations in Approach and Area Control Centres may be planned right now to avoid congestion, which is likely to be experienced soon.

4.53. **ATS Licences and Ratings**

4.53.1 Part IV Section 1 Chapter 4 of ICAO DOC 9426 deals with ATS licences and ratings. (Relevant paras reproduced).

> 4.1.1 Standardization of procedures and methods regarding the recruitment, training, performance and, where required, licensing of air traffic services (ATS) personal is essential in a service which has international obligations and uses procedures involving more than one unit. The degree of standardization achieved is directly related to the proficiency with which individuals perform their duties. This condition in turn determines the efficiency of the service given to the users and to the travelling public.
>
> 4.1.2 Individual proficiency is attained and maintained by a programme of training, proficiency evaluation checks and routine assessments, and most essentially, by the deliberate and conscientious efforts of all ATS personal.
>
> 4.1.3 While it is recognised that State employees may operate as air traffic controllers without a licence, provided they meet the retirements for this profession set out in Annex I- Personnel Licensing, it has nevertheless been found that most States prefer to issue such licenses even to their

> State employees acting in this capacity. This is mainly due to the fact that it has been recognised that this will assist in maintaining the level of confidence required to ensure collaboration between ground services and operator and/or pilots under the best possible terms, especially when such collaboration involves persons of different nationalities, background and mentalities. It is for this reason that the material presented hereafter has been based on the assumption that States are applying the practice of issuing personal licenses and ratings to each person required to act as an air traffic controller.

Whereas the system of ratings has been adopted by AAI and is in vogue, no steps have so far been taken towards licensing of ATCOs . This is in spite of the fact that the requirement had been clearly brought out by an earlier Court of Inquiry headed by Hon'ble Mr Justice U.C. Banerjee of Calcutta High Court who inquired into Indian Airlines Boeing-747 crash on 16.8.91 near Imphal (Manipur) and the recommendation had been accepted by the Govt. Under the circumstances, it is felt necessary to reiterate that there is an urgently need to introduce the scheme of ATS licensing and extend the same to IAF also so as to bring both the civil and military ATCs under the same oambit.

At present, the IAF follows the scheme of cate-

categorisation of ATS personnel which is at variance with the scheme of ratings. Since IAF ATS personal are handling civil traffic at their aerodromes, there is a strong need to adopt uniform standards. It is because of this anomaly that the national contingency plan aimed to induct IAF ATC officers in the event of a strike by civil controllers has neither been a success in the past nor likely to be so in the future. The Govt would therefore be well advised to introduce the scheme of ATS licensing without any further delay.

4.54 Accident/Incident Prevention

4.54.1 `Prevention is better than cure.' To lay greater emphasis on the preventive measures it is better to devise a system of continuous learning based on in-service experience and deficiencies observed during periodic inspections, spot checks, safety audits etc. This can be achieved by having an adequately staffed Accident/Incident Prevention Directorate in the DGCA which could propagate this activity amongst various agencies in civil aviation, namely, operators, Airport Authority, Maintenance Organisations, Fuel Vendors etc. Recommendations have been made in this regard by some of the Courts of Inquiry to have such

a set-up in the DGCA. One of the Courts (Justice U.C. Banerjee) in 1992 had recommended :-

> '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 time '

The recommendation though accepted is yet to be implemented. The need of establishing an adequately staffed full -fledged Accident/Incident Prevention Directorate in the DGCA so as to enhance the level of safety in Civil Aviation in India is emphasised and reiterated.

CHAPTER-V

Findings

CHAPTER V.

FINDINGS

5.1 Facts not in Controversy

The following factual details are either not in dispute or have been well established (Chapter II):

(a) The Kazakstan aircraft Ilyushin IL-76 TD No-UN-76435 was owned by the Shymkent Avia Kazakstan, a sister concern and subsidiary of Kazakhstan Airlines. The aircraft was on a non-scheduled chartered flight from Chimkent to Delhi on 12.11.1996.

(b) The IL-76 aircraft had a certificate of airworthiness issued by the Republic of Kazakhstan, valid upto 31-7-1997.

(c) The IL-76 aircraft took off from Chimkent on 12.11.96 at 10.25 UTC for Delhi. The flying time was about 3 hrs. There were 37 persons on board, including 5 cockpit crew and five cabin crew.

(d) The IL-76 aircraft was under the command of Capt. Alexander Rohertovich Cherepanov (PIC). The second pilot was Ermek Kozhahmetovich

Dzhanbaev (P2).In addition, there were a Flight Engineer(FE), Navigator (N) and a Radio Operator (R) as part of the cockpit crew. All of them had respective licenses.

(e) The IL-76 aircraft came in first contact with Delhi Approach at 13.04.55 and reported passing FL230 and 74 miles from DPN (Delhi). As per AAIB-DFDR time (page 00213) this transmission was 315.1 sec before collision that is to say 13.05.01 (IAC time). The IL-76 was cleared by the Delhi Approach to descend to FL 150 AT 13.05.06 and this was acknowledged by the aircraft at 13.05.16 five minutes before collision.

(f) At 13.08.54 the D-APP asked the IL-76 for the distance from DPN and the aircraft responded at 13.08.59 "Kazak-1907, now reached one five zero, four six miles from Delta Papa November (DPN)-, Radial two seven zero."As per AAIB-DFDR recordings the IL-76 was, however, at about 16439 ft at 13.08.59 (77 secs before collision).

(g) From 13.08.69 to 13.09.41 the IL-76 and the D-APP were in continuous two-way contact, during which time D-APP asked the IL-76 to maintain

FL 150 which the aircraft acknowledged. The D-APP also informed the IL-76 of the reciprocal Saudi Boeing at FL 140. In response to the D-APP asking the IL-76 to report if the Boeing is in sight, the IL-76 responded at 13.09.41, " Now looking 1907". This was the last transmission from the IL-76 to the ATC.

(h) The entire communication from the IL-76 aircraft to the ATC was by the Radio Operator and it was in English.

(i) The Saudi Boeing-747 aircraft HZ-AIH belonged to the Saudi Arabian Airlines. The aircraft was of 1982 manufacture and was airworthy as per certifications.

(j) The Saudi Boeing-747 was on a scheduled flight from Delhi to Dahran and took off from IGI Airport Delhi at 13.03 UTC on 12.11.96. There were 312 persons on board including 3 cockpit crew and 20 cabin crew.

(k) The Saudi Boeing-747 was under the command of Capt Khalid A Al-Shubaily (PIC) and the first officer was Nazir Khan (P2). The third member

of the cockpit crew was the Flight Engineer(FE). All the crew members had respective licenses.

(l) The Boeing got airborne at 13.08.50 (AAIB-DFDR time) corresponding to 1303 ATC time. On departure the aircraft was identified on radar and thereafter remained under the control of Delhi Approach Control.

(m) Initially the Boeing was cleared by ATC to climb to FL 100 and at 13:06:13 the aircraft was cleared to climb to FL 140. The aircraft reported approaching FL140 at 13:08:41 and the ATC asked the aircraft at 13:08:44 to maintain FL 140, and standby for higher. At 13:08:52 the Saudi Boeing acknowledged Saudi seven six three (will) maintain one four zero" (AAIB Report page 00216). This was the last transmission from the Saudi aircraft to the ATC.

(n) Neither in the CVR nor in the DFDR of both the aircraft is there any indication or evidence of any evasive or avoidance action having been

taken by the respective crew. During the entire period when the Delhi ATC was in contact with the two aircraft there has been no transmission from either of the aircraft to the ATC of any abnormality observed or of any real/anticipated emergency.

(o) The two aircraft collided at about 14000 ft level and at 13.10.16 UTC (IAC Moscow Report) time.

(p) There were no survivors. There was no casualty on the ground.

(q) Both the aircraft disintegrated in the air after the collision and caught fire.

(r) The wreckage was found spread in a trail of 7 Kms, 2 Kms wide, about 40 NM away west of IGI Airport, Delhi.

(s) Rescue action was initiated immediately by the local police and the civil authorities and this was followed by the rescue teams from Delhi.

(t) All Navigation aids and communication equipment at the IGI airport were serviceable at the relevant time on 12.11.1996.

5.2 Findings as to Main Issues

Based on the material available and its appreciation the Court arrives at the following findings :-

(a) The Mid-air Collision was not caused (directly or indirectly) by sabotage, internal explosion or by any cause external to the crew or the aircraft.

(b) The accident was not caused by any mechanical failure or mechanical defect of any of the two aircraft.

(c) Both the aircraft were fully airworthy and free from any mechanical/technical defect.

(d) The two aircraft collided at flight level 140 (i.e. 14,000 feet). (Para 4.10)

(e) The Saudia B-747 had been assigned FL-140 whereas the Kazak IL-76 was assigned FL-150 for a safe crossing on the reciprocal tracks. (Appendix D)

(f) Vertical separation of 1,000 feet for the crossing of the two aircraft as assigned by the Delhi Air Traffic Control was adequate and met the

ICAO standards of safety.(Para 4.32)

(g) The Saudi Aircraft meticulously maintained FL 140. (Appendices B-2(T), C-3 and D)

(h) The Kazak Aircraft descended to FL-140 (departing from the assigned FL-150) just prior to the anticipated crossing. (Appendices B-2(T), C-3 and D)

(i) The root and approximate cause of the collision was the unauthorised descending by the Kazak aircraft to FL-140 and failure to maintain the assigned FL-150. (Para 4.22)

(j) The factors contributing to the unauthorised descent of Kazak aircraft to FL-140, departing from the assigned FL-150, were (Para 4.22) :-

(i) inadequate knowledge of English language of Kazak pilot, resulting in wrong interpretations of ATC instructions.

(ii) poor airmanship and lack of proper CRM (Crew Resource Management) skill on the part of PIC (pilot in command) compounded by leadership quality lacking in him

(iii) casual attitude of the crew and lack of coordination in the performance of

their respective duties by crew of Kazak air craft.

iv) Absence of standard call-outs from any crew member.

(NB :- *Crew Resource Management* includes crew coordination, situational awareness, quality of leadership, intra crew communication)

(k) Nearly 30 seconds before collision both the aircraft had entered a cloud layer and experienced turbulence of weak to moderate intensity. The presence of the cloud did result in reduced visibility conditions. But the cloud did not cause any such severe turbulence as to result in an abrupt loss of altitude to the extent of 1000 ft. pertaining to the level of Kazak aircraft. (Para 4.26)

(l) ATC instructions to both the aircraft were clear and proper and in accordance with established procedures. (Para 4.32)

(m) Direct pilot-controller communication was not established by Kazak 1907 with Delhi ATC. (Para 4.20)

(n) Presently SSR is not available at Delhi

airport. However, installation of current generation radar (both primary and secondary) along with other ATC automated systems is already in progress. (Para 4.38)

(o) Single air corridor (bi-directional ATS route) at Delhi airport was not a contributory factor for accident. However, availability of uni-directional routes does enhance ATC's traffic handling capacity, which is in the national interest.(Para 4.37.3)

(p) Outcome of the investigation by DGCA/AAI into airmiss incidents is not being disseminated to the air traffic controllers from the training point of view.(Para 4.42.5)

5.3 Findings as to Incidental issues

(a) Altitude parameter accuracy limits in respect of FDR installed in IL-76 were not in accordance with those laid down in ICAO Annex -6 Pat I (Table D1 of Attachment).(Para 4.44)

(b) Both Boeing 747 and IL-76 were not equipped with Airborne Avoidance Collision System (ACAS). (Para 4.45)

(c) IL-76 was not equipped with

(i) Altitude Alert System, and

(ii) Altitude Acquisition System.

(d) In the organisational set-up of DGCA (India) there is no ATC element to oversee ATC aspects which presently fall under the purview of Airports Authority of India (AAI) (Para 4.44)

(e) In the organisational set-up of AAI, the highest post which an ATC professional can fill up is that of Executive Director) (Air Traffic Management) which arrangement is not adequate. (Para 4.50)

(f) Present system of civil/military ATC coordination in India. Suffers from Serious short-comings, which adversely affect air safety in India. (Para 4.50)

(g) In India, the ATC profession, which has become highly specialized due to the present day complex flying environment, does not enjoy the recognition and status it deserves.

(h) (i)working conditions at Delhi Airport ATC (present complex) are not upto the

desired standards. (Para 4.52)

(ii) Working space in the new complex specially with regard to Area/Approach Control, ATC Simulaor and IAF element is no adequate to mach their functions.

(iii) Further in view of the anticipated increase in air traffic, the present number of work stations is not considered adequate.(Para 4.52.5)

(i) In India, there is no system of licencing of air traffic controllers. Also the proficiency standards which are being followed in civil and military ATCs are not uniform. (Para 4.53)

(j) Just a `One-man accident/incident prevention cell in DGCA is not adequate.

CHAPTER-VI

Recommendations

CHAPTER VI

RECOMMENDATIONS

6.1. The requirement of proficiency in English, which is the language accepted by ICAO for radio communications on international flights, should be strictly ensured by contracting States. ICAO should devise ways and means to ensure such compliance by contracting States so as to avoid lapses on their part.

6.2. Meaningful Crew Resource Management Programme should be made an integral part of crew training curriculum with special emphasis laid on the importance of standard call-outs and its efficacy be evaluated during periodic licence renewal checks.

6.3. Before a pilot is appointed as "pilot-in-command" his having acquired effective CRM skill and qualities of leadership should be meticulously ensured.

6.4. Air-ground communications with ATC may be governed as follows :-

(a) In general, the emphasis should be on direct pilot-controller communications irrespective of crew composition.

(b) In the terminal control areas, the requirement should be of direct pilot - controller communication invariably so as to avoid time lag in compliance of ATC instructions.

(c) In the enroute phase, a crew other than pilots may handle radio communications with ATC subject to basic flying instruments being in his view.

6.5. AAI should expedite commissioning of ATC automated systems.

6.6 AAI should bifurcate ATS Route G-452 (which is a high density traffic route) into unidirectional arrival/departure corridors within the limits of Delhi TMA to coincide with the commissioning of ATS automated systems. Other bi-directional routes may also be restructured wherever warranted.

6.7 Use of DFDRs/FDRs not according to the

parameters accuracy limits (or having tolerance beyond those recommended) in ICAO Annex-6 Part-I attachment/table D-1 should not be permitted on public transport aircraft by the contracting States. This can be ensured by the regulatory agency of the country of manufacture at the time of issue of type certificate in respect of a DFDR/FDR and by ICAO taking steps to emphasise the need of implementation of its recommendation by the contracting States.

6.8. Public Transport Aircraft should be equipped with :-

(i) Airborne Collision Avoidance System (ACAS)

(ii) Altitude Alert System

(iii) Altitude Acquisition System.

6.9. Government of India should create a suitable ATC element at a senior level in the DGCA to properly oversee all aspects of ATC.

6.10 Airports Authority of India should have a Member (ATC) on its Board to look after ATC matters. Regional/Field ATC units should be placed under unified command of ATC cadre.

6.11. Govt. of India should integrate civil and military ATCs preferably on the pattern of NATS in the UK.

6.12. Govt. of India should recognise due importance of ATC profession and accord special status to it preferably by examining the feasibility of de-linking ATS from the normal organisational set-up and creating an independent cadre to be governed by separate provisions.

6.13. AAI should introduce sectorisation Controlling in approach control and re-organise working space in the Delhi airport ATC (new complex) so as to match functional requirements of Area/approach Control, ATC Simulator and IAF element. The adequacy of planned number of work stations in the new ATC should also be reviewed in the light of anticipated increase in air traffic.

6.14. Govt. of India should introduce the Scheme of licencing for controllers and make it applicable to military, too, so as to achieve uniform standards in controlling.

6.15. Govt. of India should establish an adequately staffed Accident/ Incident Prevention Directorate in the DGCA so as to enhance the level of safety in civil aviation in India.

Lahoti
15.7.97

(R.C. LAHOTI)
Judge, High Court of Delhi

(A.K. VERMA)
Assessor

(T. PANNU)
Assessor

Place : New Delhi.

Dated :- 15th July, 1997.