# FINAL INVESTIGATION REPORT



**SERIOUS INCIDENT OF TCAS – RA REPORTED BY PAKISTAN INTERNATIONAL AIRLINE FLIGHT PIA301, B77L, REG NO APBGY (ISLAMABAD – KARACHI) & EMIRATES AIRLINE FLIGHT UAE516, B777, REG NO A6EPS (DUBAI – DELHI) ON 07-01-2020**

# SCOPE

Aircraft Accident Investigation Board (AAIB), Pakistan investigations are conducted in accordance with Annex-13 to the ICAO Convention on International Civil Aviation and Civil Aviation Authority (CAA), Pakistan Rules 1994 (CARs 94).

The sole objective of the investigation of an accident or incident under above stated regulations is the prevention of future accidents and incidents of similar nature. It is not the purpose of such an investigation to apportion blame or liability. Accordingly, it is inappropriate that AAIB reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

This report contains facts which have been determined up to the time of publication. This information is published to inform the aviation industry and the public of the general circumstances of civil aviation accidents and incidents.

# TABLE OF CONTENTS

# ABBREVIATIONS

| | | |
|---|---|---|
| 1. | **ACC** | Area Control Center |
| 2. | **ACAS** | Airborne Collision Avoidance System |
| 3. | **AIRPROX** | Aircraft Proximity |
| 4. | **AMSL** | above mean sea level |
| 5. | **ANS** | Air Navigation Service |
| 6. | **ANSP** | Air Navigation Service Provider |
| 7. | **ATC** | Air Traffic Control |
| 8. | **ATCO** | Air Traffic Controller |
| 9. | **AVSA** | Adjust vertical speed adjust |
| 10. | **CPA** | Closest point of Approach |
| 11. | **CRM** | Crew Resource Management |
| 12. | **FIR** | Flight Information Region |
| 13. | **FL** | Flight Level |
| 14. | **FPL** | Flight Plan |
| 15. | **hrs** | Hours |
| 16. | **ICAO** | International Civil Aviation Organization |
| 17. | **IIC** | Investigator In Charge |
| 18. | **Km** | Kilometers |
| 19. | **LT** | Local Time |
| 20. | **m** | Metres |
| 21. | **mb** | Millibars |
| 22. | **METAR** | Meteorological Terminal Air Report |
| 23. | **No** | Number |
| 24. | **NM** | Nautical Mile |
| 25. | **OJT** | On – The – Job Training |
| 26. | **OJTI** | On – The – Job Training Instructor |
| 27. | **OK** | all correct |
| 28. | **OMDB** | Dubai |
| 29. | **OPIS** | Islamabad International |
| 30. | **OPKC** | Karachi International |
| 31. | **QNH** | Barometric pressure adjusted to sea level |

| | | |
|---|---|---|
| 32. | **RNP** | Required Navigation Performance |
| 33. | **RoD** | Rate of Descent |
| 34. | **R/T** | Radiotelephony |
| 35. | **SATI** | Station Air Traffic Instructions |
| 36. | **SDD** | Situation Data Display |
| 37. | **SOP** | Standard Operating Procedures |
| 38. | **STAR** | Standard Arrival Route |
| 39. | **STCA** | Short Term Conflict Alert |
| 40. | **TCAS** | Traffic alert and Collision Avoidance System |
| 41. | **TCAS – RA** | Traffic alert Collision Avoidance System – Resolution Advisory |
| 42. | **UTC** | Co-ordinated Universal Time |
| 43. | **VIDP** | Delhi |

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## SERIOUS INCIDENT OF TCAS – RA REPORTED BY PAKISTAN INTERNATIONAL AIRLINE FLIGHT PIA301, B77L, REG NO APBGY (ISLAMABAD – KARACHI) AND EMIRATES AIRLINE FLIGHT UAE516, B777, REG NO A6EPS (DUBAI – DELHI) ON 07-01-2020

### Synopsis

On 07th January 2020, Pakistan International Airlines flight No PIA301, Aircraft B77L, Reg No APBGY was operating from Islamabad to Karachi (OPIS – OPKC) on route Islamabad – Hangu – Nawabshah (NH) – Karachi. PIA301 was cleared to descend from FL400 to FL180 on pilot discretion by Area Radar Controller East Karachi. After few minutes Area Radar Controller East realized the close proximity of a reciprocal traffic Emirates Airline, Flight No UAE516, aircraft B77W, Reg no A6EPS operating from Dubai to Delhi (OMDB–VIDP) & maintaining FL350. The controller tried to take evasive action by assigning radar vectors / headings to both the flights, however both (PIA301 and UAE516) received Traffic Collision Avoidance System – Resolution Advisory (TCAS – RA) near Nawabshah and initiated climb and descend respectively. PIA301 climbed to FL369 and UAE516 descended to FL347 due to TCAS – RA.

This incident of TCAS – RA was reported in the daily IOU report for the period 070500LT to 080500LT January 2020. AAIB was mandated to investigate the incident vide memorandum dated 17thJanuary 2020 and corrigendum.

All available evidences have been analyzed by AAIB. No damage to the aircraft or injuries to the passengers / crew of both the flights were reported. At the time of minimum vertical separation of 400 ft, both aircraft (PIA301 and UAE516) were 06.91NM laterally separated. They crossed each other (lateral separation 0.54 NM) with a vertical separation of 1800ft as both had initiated TCAS – RA climb and descend respectively. The incident occurred due to lack of situational awareness on the part of ATC Karachi (Area Radar Controller East). Appropriate recommendations have been made for CAA Operations, CAA Regulatory and CAA Technical (CNS) Directorates.

# 1. FACTUAL INFORMATION

## 1.1 **History of Flights**.

1.1.1 On 07th January 2020 Pakistan International Airlines (State of Operator & Registry – Pakistan) Flight No PIA301 aircraft B77L Reg No APBGY was operating from Islamabad to Karachi (OPIS–OPKC) on route J139 – Nawabshah (NH) – Karachi (figure 1).


Figure 1: Route of PIA301 from Islamabad to Karachi

1.1.2 Emirates Airline (state of Operator & Registry – United Arab Emirates) Flight No UAE516 aircraft B77W Reg No A6EPS was operating from Dubai to Delhi (OMDB – VIDP) (figure 2).


Figure 2: Route of UAE516 from Dubai to Delhi

1.1.3 Air Traffic Services within Karachi FIR are being provided by Area Control Centre which is divided in different sectors. There are total four sectors and each sector is manned by following Control Positions:

(a) Area Radar Controller

(b) Area Procedure Controller (Also imparting On the Job training to another Officer on the incident day)

1.1.4 At 07:26:57 UTC PIA301 maintaining FL400, contacted ATC Karachi (Area Radar Controller East). The flight was confirmed about Radar Contact and was cleared for Nawabshah 2A (STAR). The flight was further informed to expect RNP approach for Runway 07R at Karachi.

1.1.5 At the same time ATC Karachi asked PIA301 to report ready for descend. Both calls were acknowledged by the aircraft.

1.1.6 At 07:32:14 UTC, UAE516 contacted ATC Karachi (Area Radar Controller East) and reported maintaining FL350, proceeding direct to waypoint BADUL. ATC Karachi acknowledged by informing about radar contact and asked UAE516 to proceed as cleared.

1.1.7 At 07:39:20 UTC ATC Karachi instructed PIA301 to proceed direct to waypoint MAKLI after Nawabshah which was acknowledged by the aircraft.

1.1.8 At 07:39:30 UTC, while PIA301 had not requested a descend clearance, ATC Karachi instructed PIA301 “when ready descend to FL180”, same was acknowledged by PIA301.Area Radar Controller East instructions were contrary to the instructions contained in SATI which states that the Controller should use R/T as

**“When ready descend to flight level…..Report Leaving”**

1.1.9 This descend clearance given to PIA301 was keeping in mind the traffic PIA588 aircraft ATR72 operating from Karachi to Bahawalpur maintaining FL170 (figure 3).

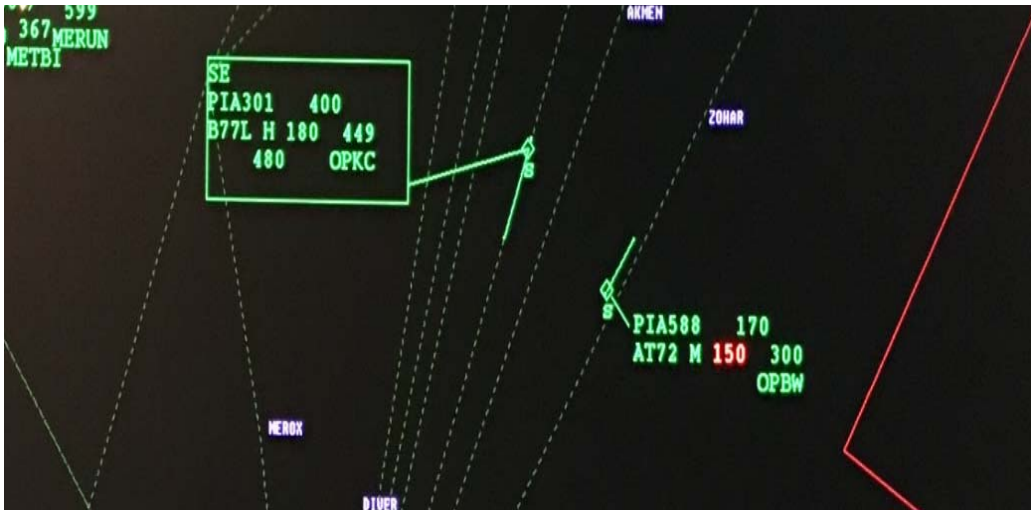



Figure 3: PIA301 maintaining FL400 and given descend to FL180 and PIA588 AT72 maintaining FL170

1.1.10 Flight Plan (FPL) Alert was instantly generated when the current FPL of PIA301 was modified by Area Radar Controller East to FL180. The same was not acted upon by Area Procedure Controller East.

1.1.11 At 07:44:22 UTC Radar Display Data shows that PIA301 vacated FL400 for FL180 while being North East of Nawabshah. UAE516 at that time was South West of Nawabshah and was maintaining FL350. Both aircraft were 70.52NM a part (figure 4).

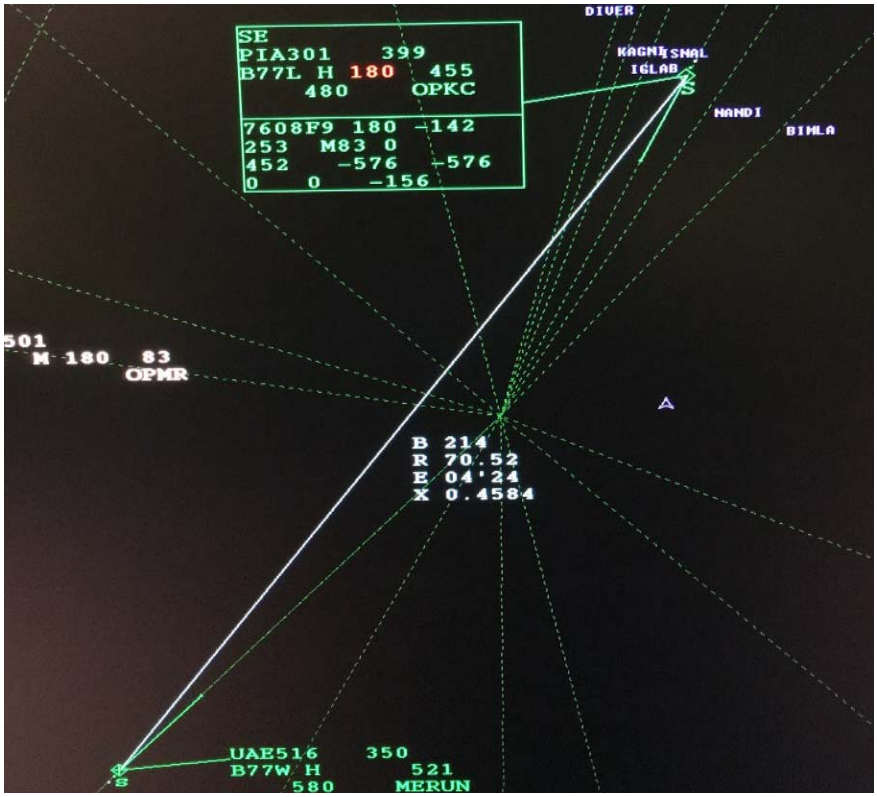


Figure 4: PIA301 leaving FL400 for FL180

1.1.12 At 07:46:30 UTC Radar Display Data shows PIA301 was passing FL374↓, whereas UAE516 was maintaining FL350 and both aircraft were approx. 36NM a part.

1.1.13 At 07:47:48 UTC Radar Display Data shows PIA301 was passing FL359↓, whereas UAE516 was maintaining FL350 and both aircraft were approx 15NM a part (figure 5).

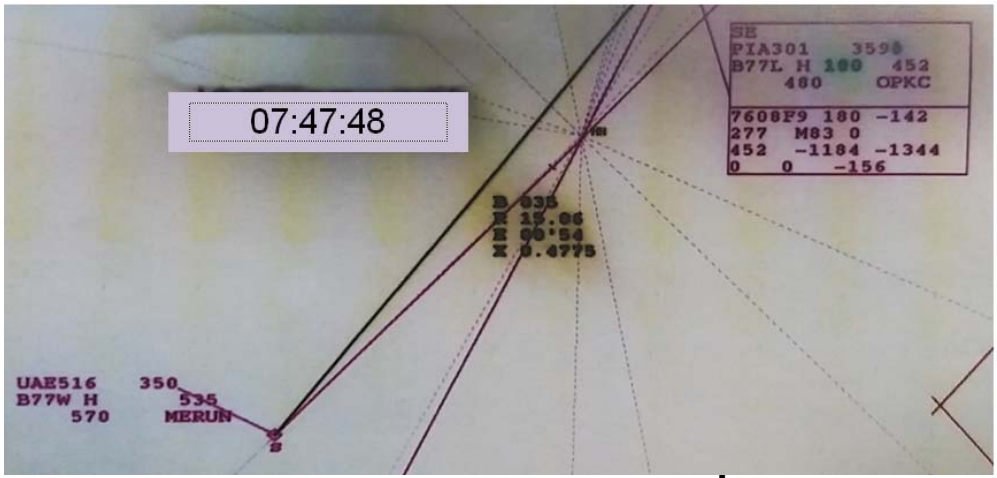


Figure 5: Showing PIA301 passing FL359↓ and UAE516 maintaining FL350

1.1.14 At 07:47:52 Radar Display Data shows for the first time Short Term Conflict Alert (STCA) (Violation Phase) warning. Whereas Prediction Phase did not activate, which was required to activate and appear as a caution about 120 seconds prior to the Violation Phase. Both aircraft were 13.69 NM apart and PIA301 was passing FL358↓ and UAE516 maintaining FL350 (figure 6).

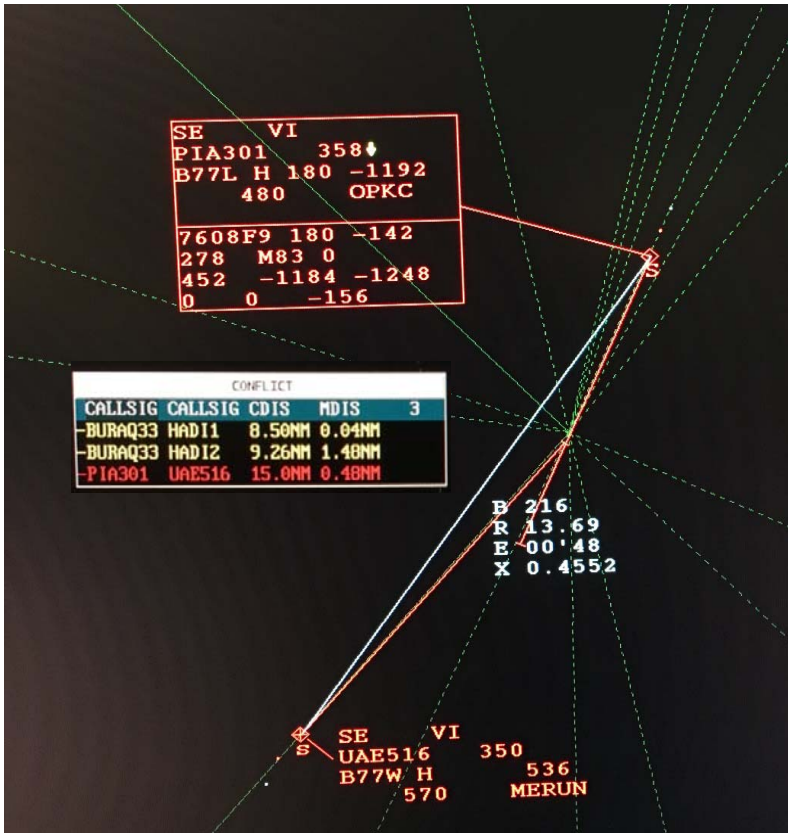


Figure 6: Showing loss of separation and activation of STCA (Violation Phase)

1.1.15 At 07:48:05 UTC Area Radar Controller East instructed UAE516 to turn left by 10 degrees for spacing. The call was repeated by saying “UAE516 turn left by 10 degree for spacing.”

1.1.16 At 07:48:15 UTC, UAE516 acknowledged the call by saying “Left” and reported TCAS-RA.

1.1.17 At 07:48:18 UTC ATC Karachi instructed PIA301 to turn left by 10 degree for spacing. Same acknowledged by PIA301.

1.1.18 At 07:48:19 UTC Radar Display Data shows PIA301 was passing FL354↓, and UAE516 was maintaining FL350 and both aircraft were approx 06.9NM a part (figure 7).

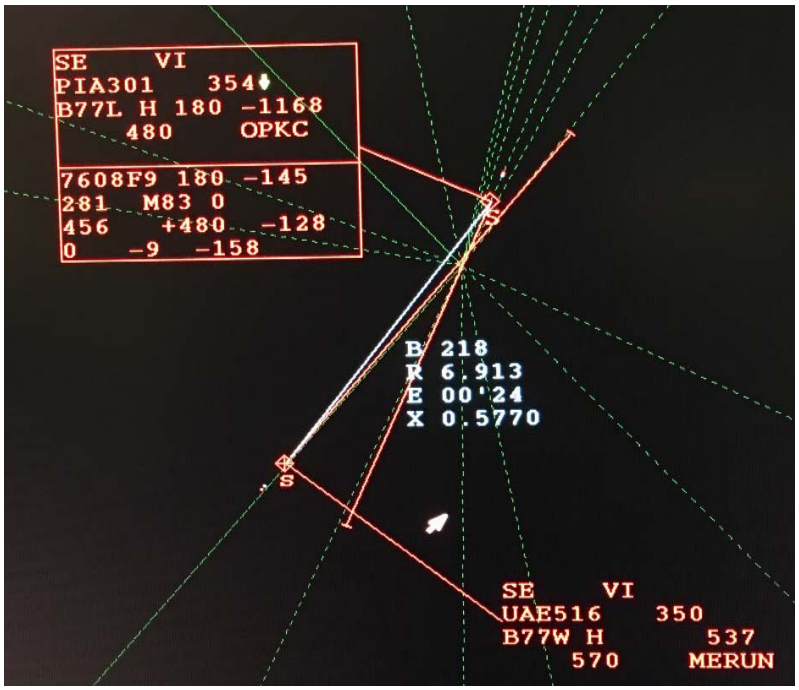



Figure 7: Showing Maximum descending level (FL354) of PIA301

1.1.19 At 07:48:21 Radar display data showing change in profile of both aircraft. PIA301 initiated climb passing FL355 (with vertical speed +2592) whereas UAE516 initiated descend passing FL349↓. Both aircraft were approx 05.5NM a part (figure 8).

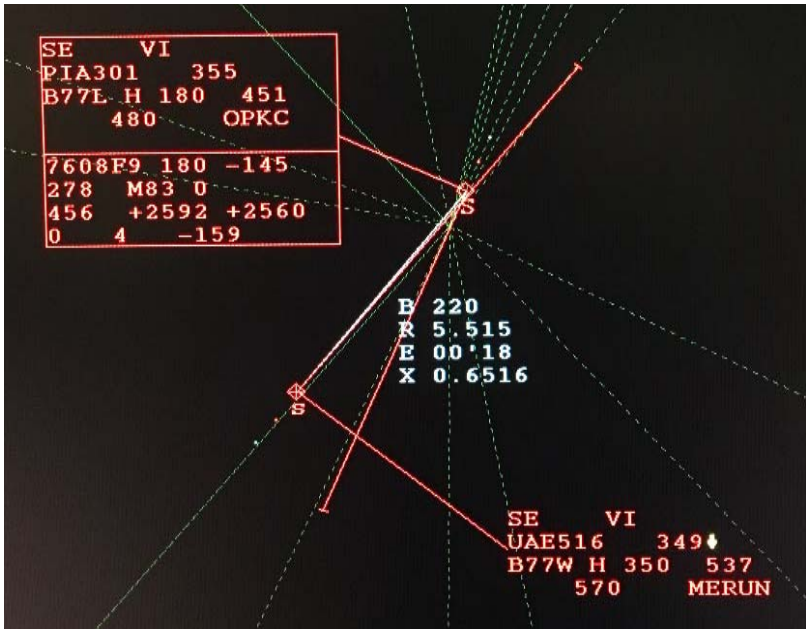



Figure 8: Showing PIA301 initiating climb and UAE516 Initiating descend due to TCAS-RA

1.1.20 At 07:48:28 Radar display data shows PIA301 passing FL358↑ and UAE516 passing FL347↓. At this both aircraft were approx04.1NM reciprocal to each other (figure 9).

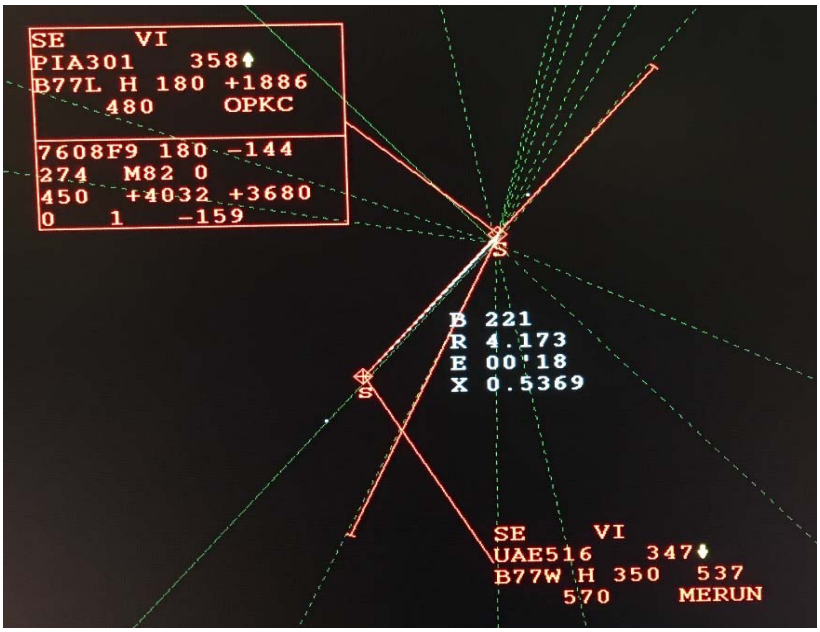



Figure 9: Showing vertical separation of more than 1000ft due to TCAS-RA climb & descend.

1.1.21 At 07:48:43 Radar display data shows that both aircraft crossing each other (lateral separation 0.54NM) with a vertical separation of 1800 ft. PIA301 passing FL366↑ and UAE516 passing FL348 (figure 10).

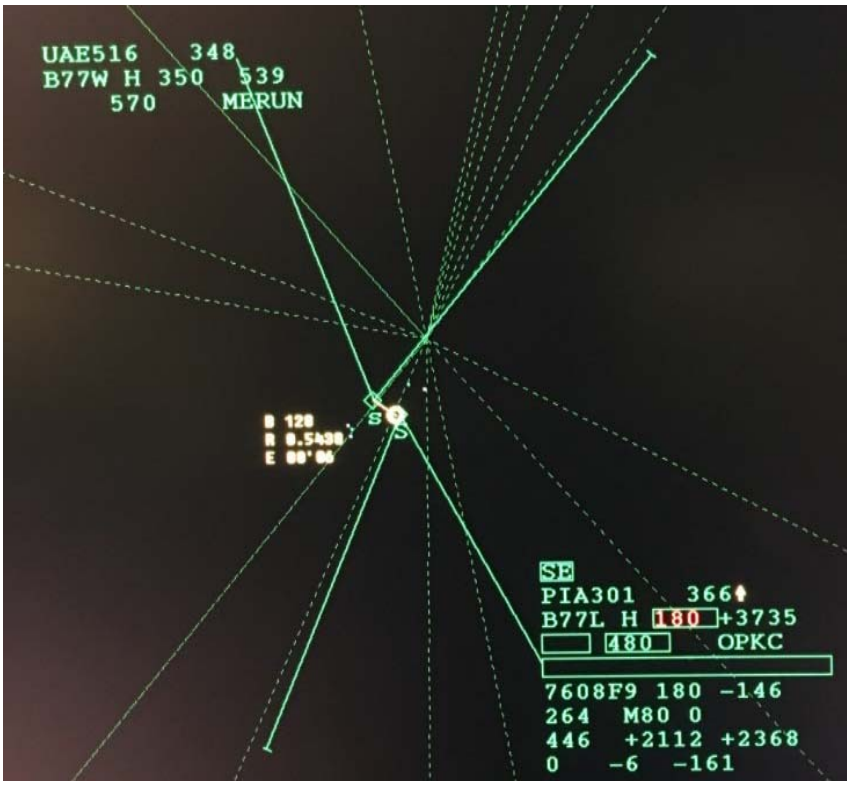



Figure 10: Showing both aircraft crossing each other with 1800ft vertical separation

1.1.22 At 07:48:47 UAE516 informed ATC Karachi that they are clear of conflict and resuming FL350. Same acknowledged by ATC Karachi.

1.1.23 At 07:48:52 Radar display data shows that both aircraft had crossed each other and 02.7NM apart. PIA301 passing FL369↑ and UAE516 maintaining FL348 (figure 11).

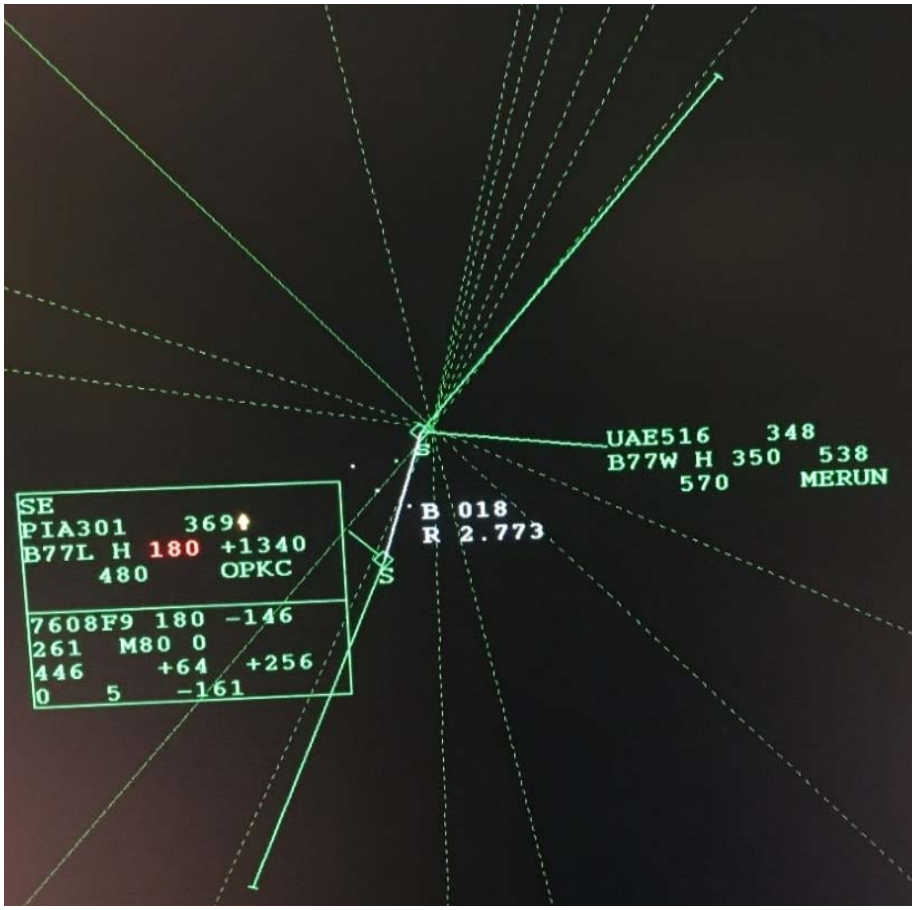



Figure 11: Showing both aircraft crossed each other

1.1.24 At 07:49:06 Radar display showing PIA301 descending and passing FL365↓ and UAE516 climbed back to FL350.

1.1.25 At 07:49:09 PIA301 informed ATC Karachi that they got TCAS-RA and confirmed if they can proceed direct to position MAKLI.

1.1.26 At 07:49:17 PIA301 informed ATC Karachi that “No traffic information was given”.

1.1.27 At 07:49:49 ATC Karachi cleared PIA301 to descend to FL100 and acknowledged by aircraft.

1.1.28 At 07:50:00 ATC Karachi confirmed from PIA301 if they got RA. PIA301 replied that’s correct. ATC Karachi reconfirmed from PIA301 that they are clear of traffic, which was confirmed by pilot that they were clear of traffic.

1.1.29 At 07:50:15 UAE516 confirmed to ATC Karachi that they also have got TCAS – RA and same acknowledged by ATC Karachi.

1.1.30 At 07:51:51 ATC Karachi instructed PIA301 to proceed direct to waypoint MAKLI and acknowledged by pilot.

1.1.31 At 07:52:03 PIA301 informed ATC Karachi that they are descending FL100. ATC Karachi advised PIA301 to contact Approach and same acknowledged by PIA301.

1.1.32 At 07:54:37 ATC Karachi instructed UAE516 to descend to FL330 and passed traffic information at R Y Khan joining same route. UAE516 acknowledged the instructions.

1.1.33 At 07:57:48 ATC Karachi inquired UAE516 that at the time of RA were they maintaining FL350. UAE516 clarified ATC Karachi whether they had cleared for FL330. ATC Karachi asked UAE516 to maintain FL330 and again asked if they got RA at NH position. UAE516 replied by saying affirmative.

1.1.34 ATC Karachi asked UAE516 that at that time were you maintaining FL350 and you did not overshoot the level. UAE516 informed ATC that they had TCAS – RA maintaining FL350.

1.1.35 At 08:04:31 ATC Karachi advised UAE516 to contact on 123.15 MHz and acknowledged by aircraft.

1.1.36 After the incident both flights continued to respective destinations.

1.2 **Injuries to person(s):** No injury was reported to any one on board both the aircraft. The crew/passenger head count for each aircraft:

PIA301 - B77L: Crew 12 and Passengers 309. Total of 321

UAE516 - B777: Crew 17and Passengers 355. Total of 372

| | **Flight Crew** | | **Cabin Crew** | | **Passengers** | | Total |
|---|---|---|---|---|---|---|---|
| | PIA301 | UAE516 | PIA301 | UAE516 | PIA301 | UAE516 | |
| Fatal | - | - | - | - | - | - | - |
| Serious | - | - | - | - | - | - | - |
| Minor | - | - | - | - | - | - | - |
| None | 02 | 03 | 10 | 14 | 297+12 (Infant) | 355 | 693 |
| Total | 02 | 03 | 10 | 14 | 309 | 355 | 693 |

1.3 **Damage to Aircraft**: No damage occurred due to this incident to any of the aircraft.

1.4 **Personnel Information**: N/A

1.5 **Aircraft Information**.

| | | | |
|---|---|---|---|
| 1.5.1. | Pakistan International Airline | : | **PIA301** |
| | Aircraft Make | : | Boeing |
| | Type of Aircraft | : | B77L |
| | Aircraft Registration | : | APBGY |
| | State of Operator / Registration | : | Pakistan |
| | Sector | : | Islamabad to Karachi |
| | Flight conditions | : | IMC / Descending Phase |
| | Altitude | : | FL354↓ (From FL400 to FL180) |
| 1.5.2 | Emirates Airline | : | **UAE516** |
| | Aircraft Make | : | Boeing |
| | Type of Aircraft | : | B77W |
| | Aircraft Registration | : | A6EPS |
| | State of Operator / Registration | : | United Arab Emirates |
| | Sector | : | Dubai to Delhi |
| | Flight conditions | : | IMC / Level Flight |
| | Altitude | : | FL350 |

1.6 **Meteorological Information**: No significant weather was reported at operating altitude at the time of occurrence of this incident of TCAS – RA.

1.6.1 METAR of Nawabshah and Karachi from time 0600 UTC to 0900 UTC:

| Time | Location | Weather |
|---|---|---|
| 0600 UTC | OPKC | 070600 05018KT 5000 FU SCT030 BKN100 16/08 Q1019 TEMPO 05015G25KT. |
| | OPNH | 070600 36006KTS 1300 FU SCT035 BKN100 13/09 Q1021 BECMG 1500 FU |
| 0700 UTC | OPKC | 070700 03015KT 5000 FU SCT035 BKN100 17/08 Q1019 TEMPO 05015G25KT |
| | OPNH | 070700 31506KTS 1500 FU SCT035 BKN100 14/09 Q1020BECMG 1800 FU |
| 0800 UTC | OPKC | 070800 04016KT 6000 FU SCT030 BKN090 17/08 Q1018 TEMPO05015G25KT. |
| | OPNH | 070800 31506KTS 2000 FU SCT020 BKN035 16/10 Q1019BECMG 2500 FU |
| 0900 UTC | OPKC | 070900 03014KT 6000 FEW030 BKN090 19/08 Q1016TEMPO 05015G25KT |
| | OPNH | 070900 36006KTS 2000 FU FEW020 SCT035 17/10 Q1018BECMG 2500 FU |

1.7 **ATC Records**: Audio Tape Extracts and Video Record (Radar Tracings / SDD Screenshots) were obtained for detailed analysis. Statements of duty Air Traffic Controllers were obtained

1.8 **Resumption of Navigation by Aircraft**: Post occurrence, both aircraft continued for their respective destinations.

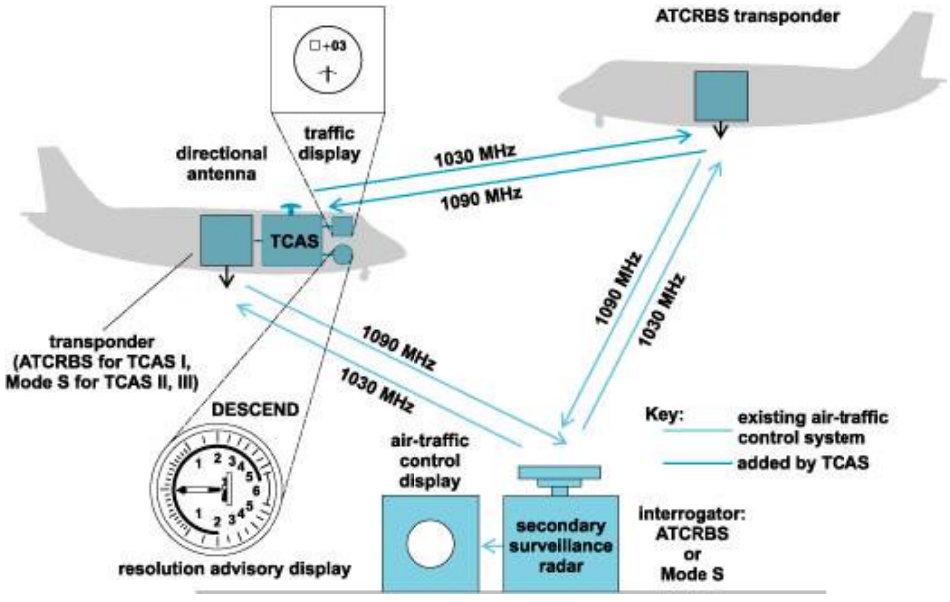
1.9 **Additional Information**

1.9.1 **Airborne Collision Avoidance System (ACAS)**.

1.9.1.1 The objective of an airborne collision avoidance system (ACAS, usually pronounced as ay-kas) is to provide advice to pilots for the purpose of avoiding potential collisions. This is achieved through resolution advisories (RAs), which recommend actions (including maneuvers), and through traffic advisories (TAs), which are intended to prompt visual acquisition and to act as a precursor to RAs. ACAS II RAs do not indicate horizontal escape maneuvers.

1.9.1.2 ACAS has been designed to provide a back-up collision avoidance service for the existing conventional air traffic control (ATC) system while minimizing unwanted alarms in encounters for which the collision risk does not warrant escape maneuvers. The operation of ACAS is not dependent upon any ground-based systems.

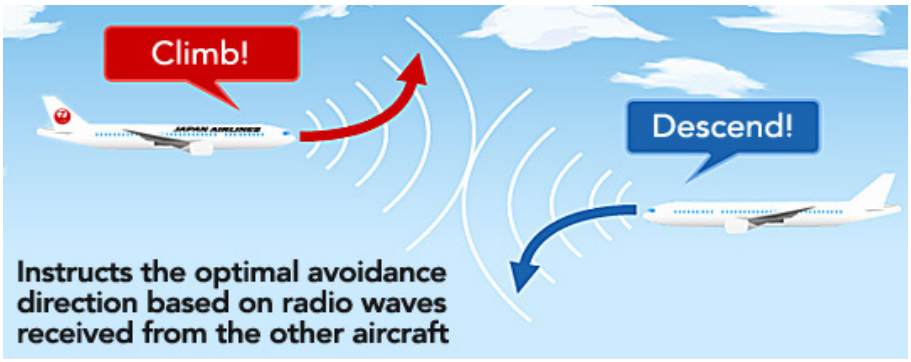
1.9.1.3 ACAS II is an aircraft system based on Secondary Surveillance Radar (SSR) transponder signals. ACAS II interrogates the Mode C and Mode S transponders of nearby aircraft (‘intruders’) and from the replies tracks their altitude and range and issues alerts to the pilots, as appropriate. ACAS II will not detect non-transponder-equipped aircraft and will not issue any resolution advice for traffic without altitude reporting transponder.



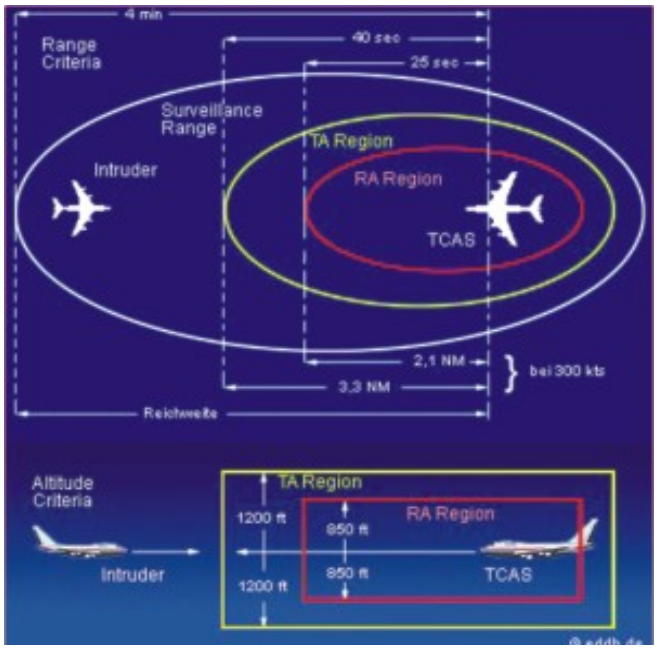

1.9.1.4 Two types of alert can be issued by ACAS II - TA (Traffic Advisory) and RA (Resolution Advisory). The former is intended to assist the pilot in the visual acquisition of the conflicting aircraft and prepare the pilot for a potential RA.

1.9.1.5 If a risk of collision is established by ACAS II, an RA will be generated. Broadly speaking, RAs tell the pilot the range of vertical speed at which the aircraft should be flown to avoid the threat aircraft. The visual indication of these rates is shown on the flight instruments. It is accompanied by an audible message indicating the intention of the RA. A "Clear of Conflict" message will be generated when the aircraft diverge horizontally.

1.9.1.6 Once an RA has been issued, the vertical sense (direction) of the RA is coordinated with other ACAS II equipped aircraft via a mode S link, so that two aircraft choose complementary maneuvers. RAs aim for collision avoidance by establishing a safe vertical separation (300 - 700 feet), rather than restoring a prescribed ATC separation.




1.9.1.7 ACAS II operates on relatively short time scales. The maximum generation time for a TA is 48 seconds before the Closest Point of Approach (CPA). For an RA the time is 35 seconds. The time scales are shorter at lower altitudes (where aircraft typically fly slower). Unexpected or rapid aircraft maneuver may cause an RA to be generated with much less lead time. It is possible that an RA will not be preceded by a TA if a threat is imminent. The effectiveness of an RA is evaluated by the ACAS equipment every second and, if necessary, the RA may be strengthened, weakened, reversed, or terminated.



1.9.2 **Separation Standards:**

1.9.2.1 AIP Pakistan ENR Section (Page 1.6-1) ATS Surveillance Services and Procedures (Separation Minima based on ATS Surveillance System) states:

> ***"Following separation minima is applicable within Karachi and Lahore FIRs:***
>
> ***(a) 5 NM horizontal separation within the terminal airspace using any surveillance sensor of PSR, SSR, ADS-B and / or MLAT (upto maximum of 60NM) at or below FL255.***
>
> ***(b) 15 NM horizontal separation for use outside terminal airspace in enroute phase of flight using any of the above available surveillance sensor."***

1.9.2.2 The Vertical Separation Minimum (VSM) specified in ICAO Doc4444 (PANS-ATM) at para 5.3.2 states that,

> ***"The vertical separation minimum (VSM) shall be:***
>
> ***(a) A nominal 300 m (1000 ft) below FL 290 and a nominal 600 m (2000 ft) at or above this level, except as provided for in b) below; and***
>
> ***(b) Within designated airspace, subject to a regional air navigation agreement: a nominal 300 m (1000 ft) below FL 410 or a higher level where so prescribed for use under specified conditions, and a nominal 600 m (2000 ft) at or above this level"***

1.9.3 **Traffic Information**:

1.9.3.1 ICAO Doc4444 (PANS-ATM) defines traffic information as:

> ***"Information issued by an air traffic services unit to alert a pilot to other known or observed air traffic which may be in proximity to the position or intended route of flight and to help the pilot avoid a collision."***

1.9.3.2 Furthermore ICAO Doc4444 Section 5.10.1.1 and 5.10.1.2 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, or will not be, separated from other controlled traffic by the appropriate separation minimum."***
>
> ***"Essential traffic information shall be given to controlled flights concerned whenever they constitute essential traffic to each other."***

1.9.4 **Flight Plan Alert (FPA) / Short Term Conflict Alert (STCA)**

1.9.4.1 Flight Plan Alert generates when there is a potential conflict between two flights as soon as Flight plan or any amendment in the flight plan is entered in the system. SATI JIAP Karachi Chapter 3 Section 3.2.2.1.4 states one of the duty of the Area Procedure Controller is :

***"Acknowledgement and manipulation of FPL(s) showing alerts such as FP / MSAW / APW / CLAM / RAM."***

1.9.4.2 SATI JIAP Karachi Chapter 3 Section 3.6.4.4 states: It is a ground based safety net function intended to assist the controller in maintaining standard separation between controlled flights by generating in timely manner, it is an alert of a potential infringement of separation minima. STCA has two phases:

(a) Prediction Phase: It generates 120 seconds prior to potential infringement of separation minima;

(b) Violation Phase: It generates at the time of loss of standard separation minima.

1.9.4.3 Action to be taken by Duty Controller in case of STC Alert:

(a) In the event when an STCA Prediction is generated, the duty controller shall immediately take appropriate action to ensure that applicable separation minima is not infringed.

(b) In the event when an STCA Violation is generated, the duty controller shall immediately take appropriate action to separate the aircraft and whenever possible shall pass the essential traffic information to the concerned aircraft.

1.9.5 **Coordination Procedures**

1.9.5.1 SATI (The Station Air traffic Instructions) JIAP (MNL-001-KCAT-3.0) in (Duties of Area Radar Controller) section 3.2.2.2 (Subsection 3.2.2.2.4 states:

***"Area Radar Controller shall be responsible to the Team Leader for:***

***Providing Air Traffic Services based on Radar to the air traffic operating in his/her area of jurisdiction in coordination with Area Procedure Controller and according to the provisions laid down in AIP (Pakistan), MATS and local instructions issued from time to time."***

1.9.6 **R/T Phraseology and ATC Clearance**

1.9.6.1 SATI (The Station Air traffic Instructions) JIAP (MNL-001-KCAT-3.0) under section 3.3.2 subsection 3.3.2.5.7 (R/T Phraseology and ATC Clearances) states:

***"When ready Descend to flight level….. Report Leaving"***

1.9.4 **ATC Refresher Training / Courses:**

1.9.4.1 PCAA Air traffic Controllers training Manual Chapter 4, Section 4.12 states:

***"All Air traffic Control Officers must undergo ATS Refresher training at least once in ten years. Operation Directorate shall prepare schedule for refresher training in coordination with Principal CATI. ATS units shall ensure availability of concerned ATC Officers for refresher training. In case of any training limitation at CATI or sparability of Air traffic Controllers, refresher Courses may be conducted at ACC Simulators under the supervision / control of ATS/COM. OPS School CATI."***

1.9.4.2 The ATC system is a highly complex safety critical system with countless anticipated and unanticipated paths to failure. As the controllers become sensitive to the potential paths to failure, they develop failure-sensitive strategies to counteract failure paths. An emergency presents controllers with many challenging issues. Is the situation unusual and how far to pursue monitoring of the situation? As soon as a disturbance is detected, a problem-to-be-solved is formulated and the need to re-plan for the situation becomes prominent. To respond to an emergency, controllers should demonstrate problem-detection skills and re-planning strategies. As an occurrence evolves over time, new threats may appear whilst current threats may change their demands. The need for gathering new information to fill in the gaps, correct explanations, clarify assumptions and evaluate candidate hypotheses is amplified. This calls for strategies in recognizing the situation, anticipating how the situation will evolve in future, and how to manage uncertainty.

1.9.4.3 On the other hand, the joint performance of controllers and supervisory systems is equally challenged in an emergency. ATC requires synchronization of many inter-dependent activities within a short time window and this calls for demonstration of joint cognitive strategies. Coordination is the main prerequisite for synchronization but it comes at the cost of information exchange. New tasks are added and ordinary prioritization is altered. Therefore, increased workload must be balanced by intra-team reallocation of tasks. In addition, safety critical situations are not tolerant of errors, which imply that controllers should “engineer” their own opportunities for error detection and correction.

1.9.4.4 Annual refresher courses for operational air traffic controllers are aimed at training and equipping them with the required skills and knowledge to meet successfully the demands of emergencies and abnormal situations (EAS). There is an assumption that completing a refresher course, where classroom lessons and simulator scenarios cover standardized procedures for a range of abnormal situations, will prepare controllers to manage effectively similar situations that may encounter in actual operations. Controllers are expected to build up an inventory of technical skills and revive procedural knowledge during short courses on high fidelity simulators.

1.9.4.5 Refresher training is designed to review, reinforce or enhance the existing knowledge and skills of air traffic controllers to provide a safe, orderly and expeditious flow of air traffic and shall contain at least:

(a) Standard practices and procedures, using approved phraseology and effective communication,

(b) Abnormal and emergency situations training, using approved phraseology and effective communication, and

(c) Human factors training.

1.9.4.6 Refresher training can be an opportunity to give air traffic controllers some exposure (usually through practical training, case studies or theory) to various situations that they are not likely to experience on a regular basis. Whilst exposure to these situations has some benefits, there can be significantly more benefit if the training is designed with the aim of analyzing and enhancing performance.

# 2. ANALYSIS

2.1 PIA301 was operating from Islamabad to Karachi and came in contact with ATC Karachi (Area Radar Controller East) short of NH (Nawabshah). PIA301 was maintaining FL400. The aircraft was given Air Traffic Control clearance and asked to report ready for descend.

2.2 UAE516 was operating from Dubai to Delhi and came in contact with ATC Karachi (Area Radar Controller East) South West of Karachi maintaining FL350 and was proceeding direct to waypoint “BADUL”.

2.3 ATC Karachi instructed PIA301 “when ready descend to FL180”, same was acknowledged by PIA301. Area Radar Controller East instructions were contrary to the instructions contained in SATI.

2.4 For such descend clearance, the Area Radar Controller East and the Area Procedure Controller East were required to coordinate first. This prior descend coordination was not done for PIA301.

2.5 Flight plan alert was instantly generated when the current FPL of PIA301 was modified by Area Radar Controller East for descend to FL180. However the same was missed by Area Procedure Controller East, and he did not acted upon the alert.

2.6 After approximately 04 minutes later PIA301 started descend to FL180 and did not informed ATC Karachi of leaving FL400. At this moment UAE516 was maintaining FL350 and approx 70NM reciprocal to PIA301.

2.7 After 03 minutes 14 seconds of vacating FL400, PIA301 was passing FL359↓. At that time the reciprocal traffic ie UAE516 was 15NM, and was still maintaining FL350.

2.8 The STCA (Violation Phase) generated at 07:47:52 UTC, whereas no STCA (Prediction Phase) was activated by the system.

2.9 As the configuration of ATM database for activation of STCA was set at horizontal distance of 17 NM when the vertical separation is less than or equals to 800 feet, the Prediction Phase alert was not generated. Subsequently STCA violation alert activated directly, without giving any prediction / anticipation of conflict. The prediction alert did not activate because of the parameters set by the user.

2.10 Area Radar Controller East once realizing the confliction between both aircraft (PIA301 passing FL355↓ for FL180 and UAE516 maintaining FL350 and approximately 09NM apart) initiated evasive maneuver by instructing UAE516 to turn left by 10 degrees for spacing. At this point both aircraft were 08-09NM reciprocal to each other. No traffic information was given with evasive action.

2.11 Both aircraft informed ATC Karachi that they have received TCAS – RA and initiated avoidance action. PIA301 stopped descend at FL354 and initiated climb whereas UAE516 started descend from FL350 due to TCAS – RA. At the time of minimum vertical separation of 400 ft, both aircraft (PIA301 & UAE516) were 06.91NM laterally separated. They crossed each other (lateral separation 0.54 NM) with a vertical separation of 1800ft as both had initiated TCAS – RA climb and descend respectively.

2.12 Duty Air Traffic Controller (Area Radar Controller East) while giving descend clearance to PIA301 from FL400, missed the reciprocal traffic UAE516 maintaining FL350.Duty Controller initiated evasive maneuver as soon as he realized that both the aircraft are getting close to each other, but it was little late, and could not be complied because of TCAS – RA.

2.13 Duty Air Traffic Controller (Area Procedure Controller East) was supervising a student. He too overlooked the conflict. Furthermore he also did not acted upon the activation of FPL Alert.

# 3. CONCLUSION

## 3.1 Findings

3.1.1 Both the flights (i.e. PIA301 & UAE516) were in contact with ATC Karachi (Area Radar Controller East) on Radar display and R/T.

3.1.2 Area Radar Controller East cleared PIA301 to descend to FL180 whenever ready, missing out the instructions to report leaving / vacating level.

3.1.3 The descent of PIA301 was planned for FL180 keeping in mind another reciprocal traffic at FL170 (PIA588 ATR72 OPKC – OPBW). Whereas Area Radar Controller East missed the additional reciprocal traffic (UAE516 maintaining FL350 and was 80NM away) at a higher level than PIA588.

3.1.4 The FPL Alert was activated, but Area Procedure Controller East did not act upon the alert.

3.1.5 STCA (Prediction Phase) was not generated. Whereas, it should be generated 120 seconds prior to potential infringement of separation minima, and once the separation minima is infringed, STCA (Violation Phase) should be activated. The configuration of ATM database for activation of STCA was set at horizontal distance of 17 NM when the vertical separation is less than or equals to 800 feet.

3.1.6 On the activation of The STCA (Violation Phase) Area Radar Controller East tried to take evasive measure and instructed UAE516 and PIA301 to turn left by 10 degrees. At the same time UAE516 reported TCAS – RA and both the aircraft initiated climb and descend due TCAS – RA.

3.1.7 Area Procedure Controller East was unable to provide necessary coordination / assistance to the Area Radar controller East about the overall situation, contrary to the instructions contained in JIAP SATI (Station Air Traffic Instructions).

3.1.8 At the time of minimum vertical separation of 400 ft, both aircraft (PIA301 & UAE516) were 06.91NM laterally separated. They crossed each other (lateral separation 0.54NM) with a vertical separation of 1800ft as both had initiated TCAS – RA climb and descend respectively.

3.1.9 After the incident both flights continued to respective destinations.

## 3.2 Cause(s) /Contributory factors of Occurrence

### 3.2.1 Cause.

3.2.1.1 Lack of situational awareness on part of Duty Air Traffic Controller (Area Radar Controller East) who while issuing descent clearance to PIA301 (From FL400 to FL180), keeping in mind another reciprocal traffic (PIA588 maintaining FL170) missed out another reciprocal traffic UAE516 (maintaining FL350). Upon activation of STCA (Violation Phase), his evasive maneuver was too late.

3.2.2 **Contributory Factors.**

3.2.2.1 Lack of coordination / assistance on the part of Duty Air Traffic Controller (Area Procedure Controller East) for not been able to anticipate the traffic conflict, contributed to the occurrence. Furthermore he missed the Flight Plan Alert and did not act upon the alert.

3.2.2.2 STCA (Violation Phase) activated directly, without giving any prediction / anticipation of conflict. The STCA (Prediction Phase) did not activate because of the parameters set by the user and deprived the controller a safety feature provided in the system of anticipation of conflict.

# 4 SAFETY RECOMMENDATIONS

4.1 Pakistan CAA (Operations Directorate) is to issue necessary instructions to field ATS Units for adhering to the laid down procedures for the provisioning of Air Traffic Services in accordance with ICAO guidelines and best practices, with special emphasis on the aspects related to this serious incident.

4.2 Pakistan CAA (Operations Directorate) is to issue necessary instructions to field ATC Units for adhering to the laid down procedures related to coordination between Area Procedure Controller and Area Radar Controller with specific focus on the coordination lapse related to this serious incident.

4.3 Pakistan CAA (Operations Directorate) is to coordinate with Technical Directorate (CNS Engg) for re-evaluating the parameters set for STCA Prediction Phase and Violation Phase so that the Controller should have enough margin for taking avoidance actions. Directorate of Aerodrome and Airspace Regulations (DAAR) is to provide necessary guidelines (if required) to Operations Directorate for standardization among all such facilities.

4.4 Pakistan CAA (Operations Directorate) is to introduce simulator sessions (on ACC simulators) at field level (Karachi, Lahore, and Islamabad) at a specified periodicity, for all the Air Traffic Controllers. This utilization of ACC simulators be aimed to enhance and refine the skills and identify areas of additional attention / training requirements etc. Required improvements may be undertaken in the training manual, and directions to field ATS Units may be issued to plan, execute and document such simulator sessions. Directorate of Aerodrome and Airspace Regulations (DAAR) may be consulted for plan and documentation of such sessions.

4.5 CAA ATC Training Manual provides an overview of refresher training mechanism. CAA Pakistan (Operations Directorate) is to revisit the criteria, duration and define a periodicity of the said refresher training, and undertake necessary improvements in the scope of training. Administrative measures may be incorporated to ensure that this training is accorded due priority, its curriculum is to be reviewed from time to time, and all the air traffic controllers must undergo this training mandatorily at the specified intervals. In this regard the training program / material may be shared with Directorate of Aerodrome and Airspace Regulations (DAAR) for their input and evaluation on compliance with international standards.