

FINAL INVESTIGATION REPORT



SERIOUS INCIDENT (TCAS – RA) BETWEEN EMIRATES FLIGHT UAE600, BOEING 777-31H(ER) AIRCRAFT, REG. NO. A6-ENK (SECTOR OMDB TO OPKC) AND MILITARY AIRCRAFT ON 13-07-2018

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SCOPE

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The sole objective of the investigation and the final report of an accident or serious 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 to use BASI Pakistan investigation reports 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. Such information is published to inform the aviation industry and the public about the general circumstances of civil aviation accidents and incidents.

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ABBREVIATIONS

AAIB	Aircraft Accident Investigation Board
ATC	Air Traffic Control
BASI	Bureau of Aircraft Safety Investigation
CARs	Civil Aviation Rules
FL	Flight Level
ft	Feet
h	Hour
hPa	Hectopascal
ICAO	International Civil Aviation Organization
IOU	Incident Occurrence and Unserviceability Report
kts	Knots
MAC	Mid-Air Collision
MET	Metrological
min	Minute(s)
MMR	Masroor Military Radar
NM	Nautical Miles
OMDB	Dubai International Airport
OPKC	Jinnah International Airport
OPMR	PAF Base Masroor
PAF	Pakistan Air Force
PCAA	Pakistan Civil Aviation Authority
UAE	United Arab Emirates
UTC	Universal Time Coordinated

INTRODUCTION

This serious incident was reported to Bureau of Aircraft Safety Investigation (BASI), Pakistan previously known as Aircraft Accident Investigation Board (AAIB), Pakistan, by Pakistan Civil Aviation Authority (PCAA) vide Incident Occurrence and Unserviceability Report (IOU)¹. Ministry of Aviation, Government of Pakistan issued Memorandum and Corrigendum² issued by BASI, Pakistan to investigate the serious incident. The investigation has been conducted by BASI, Pakistan. All corresponding timings are mentioned in Universal Coordinated Time (UTC).

¹ PCAA IOU Report dated 13th July, 2018

² Ministry of Aviation Memorandum No. HQCAA/1904/40-128/SIB/383 dated 13th August, 2018 & BASI Corrigendum No. BASI/1904/40-128/Inv/

SYNOPSIS

On 13th July, 2018, Emirates flight UAE600, Boeing 777-31H(ER) aircraft, Reg. No. A6-ENK was enroute from Dubai International Airport (OMDB), Dubai, United Arab Emirates (UAE) to Jinnah International Airport (OPKC), Karachi, Pakistan following the Air Traffic Service (ATS) route ALPOR – G216 – LOTAT – OPKC.

While descending to Flight Level (FL)140, approximately 09 Nautical Miles (NM) South of Masroor, UAE600 received Traffic alert and Collision Avoidance System (TCAS) – Resolution Advisory (RA) to “CLIMB”, due to nearby Military traffic.

A formation of 02 x Mirage, Military aircraft call sign ARCHER-1 & ARCHER-2, was operating within Karachi Control Zone under a coordinated Instrument Let Down at Pakistan Air Force (PAF) Base Masroor (OPMR) from a coordinated level FL120. ARCHER-2 climbed to FL149 while approaching close to UAE600 on a crossing track triggering TCAS – RA. In response to which UAE600 climbed up to FL156. Masroor Military Radar (MMR) informed that both Military aircraft reported maintaining FL120 all the way and this might be due to false MODE-C indication of Military aircraft. At the time of incident, minimum vertical separation of 200 feet (ft) and lateral 6.3 NM existed between UAE600 and Military aircraft.

SECTION 1 - FACTUAL INFORMATION

1.1. History of the Flight

1.1.1. On 13th July, 2018, Emirates flight UAE600, Boeing 777 aircraft, Reg. No. A6-ENK was operating from OMDB Dubai, UAE to OPKC, Karachi, Pakistan on ATS route ALPOR – G216 – LOTAT – OPKC.

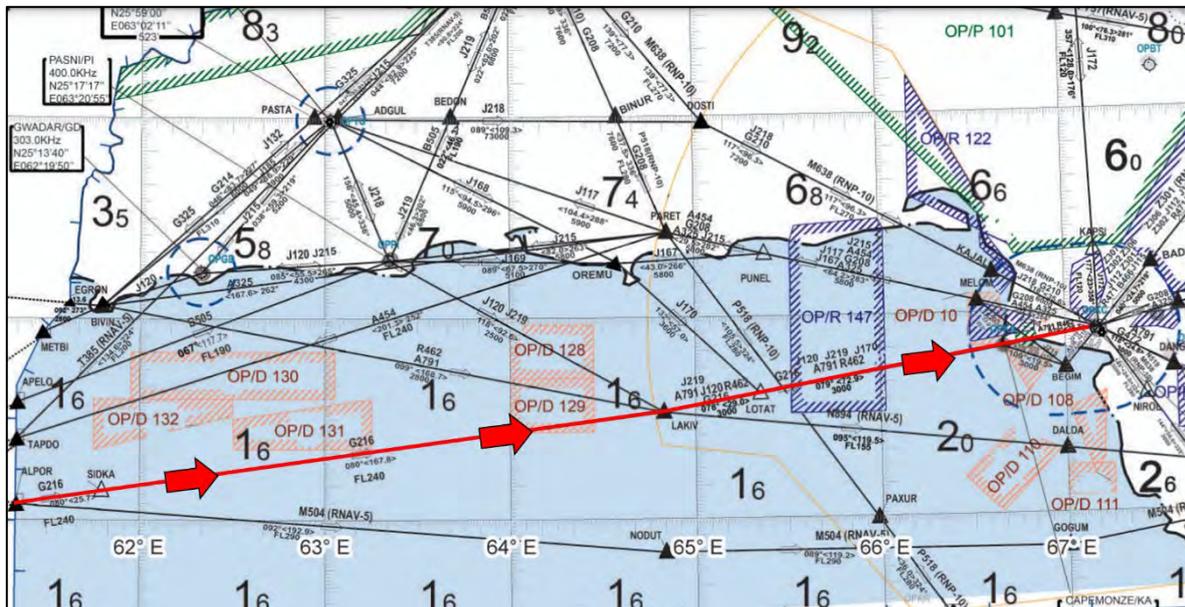


Figure 1 UAE600 Route Plan

1.1.2. At 05:44:00 hours (h), UAE600 contacted Karachi Approach passing FL254 for FL150 direct to BEGIM. UAE600 was further given descend to FL110.

1.1.3. At 05:45:56 h, UAE600 was re-cleared to descend FL140.

1.1.4. At 05:48:43 h, Karachi Approach advised UAE600 to expect lower level after 03 minutes (min) due to Military traffic operating at FL120 in Karachi Control Zone as informed by MMR Planner.

1.1.5. Military traffic, a formation of 02 x Mirage aircraft (ARCHER-1 & ARCHER-2) was carrying out Instrument Let Down at OPMR from a coordinated flight level (FL120) in contact with MMR.

1.1.6. At 05:50:06 h, UAE600 reported traffic at 3 o'clock (which was actually 10 o'clock) just 200 ft below, upon which Approach Controller informed UAE600 about the Military traffic maintaining FL120, crossing from left to right.

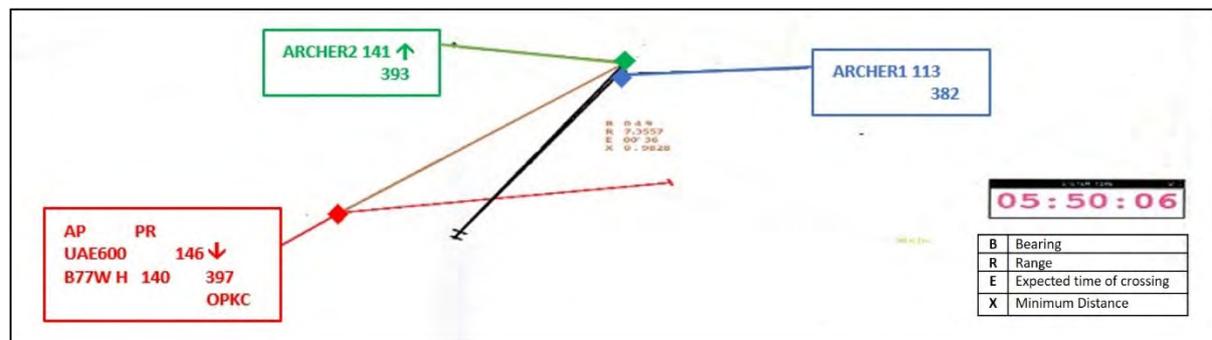


Figure 2 Presence of military traffic in climbing phase out of FL141

1.1.7. At 05:50:17 h, UAE600, reported and initiated TCAS – RA climb.

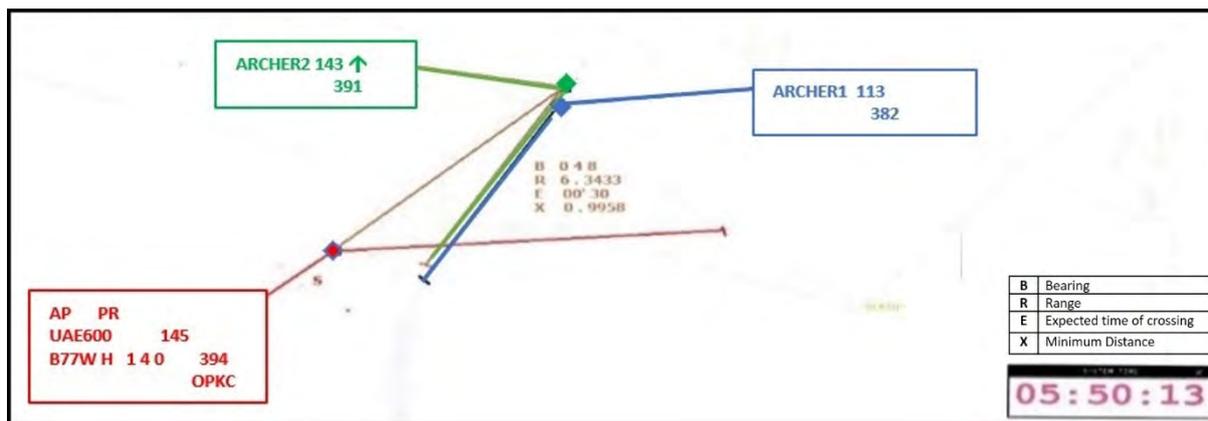


Figure 3 UAE600, reported TCAS – RA

1.1.8. At 05:50:32 h, UAE600 informed “traffic insight and clear of conflict”.

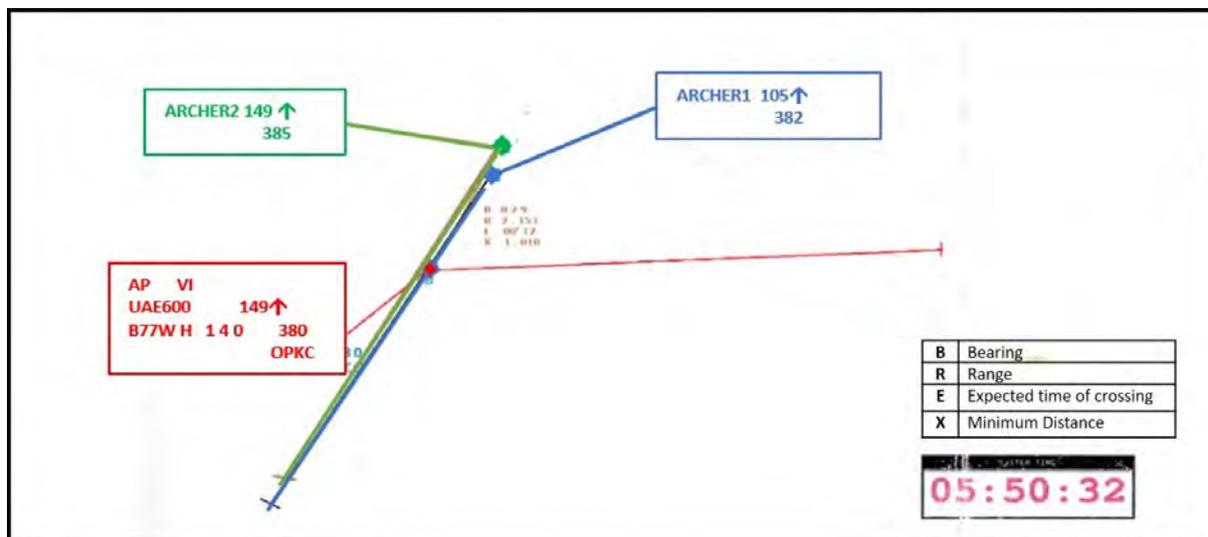


Figure 4 Traffic insight and clear of conflict

1.1.9. At 05:50:38 h, Approach Controller confirmed from MMR about the flight level which Military aircraft were maintaining as UAE600 received TCAS – RA alert, in response to query MMR informed that Military aircraft were maintaining FL120.

1.1.10. At 05:51:09 h, after confirmation from MMR, Approach Controller informed UAE600 that Military traffic was maintaining FL120 but air crew of UAE600 insisted that Military traffic was visual to UAE600 with 200 ft separation. Same was conveyed to MMR who informed that it was confirmed from Military aircraft that they maintained FL120 all the time (till inbound where decent starts).

1.1.11. At the time of incident, minimum vertical separation of 200 ft and lateral 6.3 NM existed between UAE600 and ARCHER-2 Military aircraft³.

1.1.12. Thereafter, Military formation proceeded for their mission profile and UAE600 continued its flight to its destination without any further incident.

1.2. Injuries to Person(s)

1.2.1. No injury was reported to any person on board any of the aircraft.

³ Refer Figure 3

1.3. Damage to Aircraft

1.3.1. No damage was reported due to this incident to any of the aircraft.

1.4. Other Damage

1.4.1. Not Applicable.

1.5. Personnel Information

1.5.1. Not Applicable.

1.6. Aircraft Information

UAE600	
Aircraft Make & Model	Boeing 777-31H(ER)
Registration Marking	A6-ENK
Manufacturer Serial No.	38991
Operator	Emirates
Sector	OMDB to OPKC

Table 1 UAE600 Aircraft Information

ARCHER-1 & ARCHER-2	
Aircraft Make & Model	Dassault Mirage
Registration Marking	N/A
Manufacturer Serial No.	N/A
Operator	Pakistan Air Force
Sector	OPMR - OPMR

Table 2 Military aircraft's Information

1.7. Meteorological Information

1.7.1. No significant weather was reported at OPKC, Karachi at the time of the incident.

Meteorological Aerodrome Report (METAR) Karachi
OPKC 130530Z 26006KT 5000 SCT020 BKN100 32/22 Q997 NOSIG

Table 3 METAR details OPKC, Karachi

METAR Karachi	
OPKC	(Station ID) Karachi
130530Z	(Date and Time) Day 13, Time 05:30 UTC
260/06	Wind Direction & Speed- Wind Direction: 260°, Speed: 06 knots (kts)
5000	Visibility- 5,000 meters (m).
SCT020,	Cloud layers scattered at 2000 ft,
BKN100	Cloud layer broken at 10,000 ft
32/22	Temperature: 32°C, Dewpoint: 22°C
Q997	Altimeter setting - Air pressure QNH 997 Hectopascal (hPa)
NOSIG	No significant change is expected within the next 2 hours

Table 4 METAR description at time 130530Z

1.8. Aids to Navigation

1.8.1. Navigational Aids for OPKC, Karachi are provided below: -

Type of aid. CAT of ILS (VAR VOR/ILS)	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
GP 25R LLZ 25R ILS CAT I (1°E/1995)	Dots/Dashes IKC	334.4 MHZ 110.1MHZ	H24 H24	245448.11N 0671029.32E 245413.64N0670837.68E	- -	- -
LOM MM	KO	235 KHZ 75 MHZ	H24 H24	*245547.51N 0671449.66E *245454.06N 0671117.40E	- -	3.9 NM FM THRRWY 25R 0.43 NM FM THRRWY 25R
GP/TDME 25L LLZ25L ILS CAT1 (1°E/1995)	Dots/Dashes IQA	333.2 MHZ CH34X 109.7 MHZ	H24 H24	245433.50N 0671017.88E 245359.09N0670820.434E	30.90M -	2.98°RDH55 FT -
NDB	KC	271 KHZ	H24	245523.80N 0670936.28E	-	Coverage 500NM
VOR / DME	KC	112.1 MHZ CH 58X	H24	245443.06N 0671053.91E	40.84M	Coverage 200NM Radial 300 un-reliable

Table 5 Radio Navigation & Landing Aids OPKC, Karachi

1.8.2. There was no abnormality reported regarding Navigational Aids at OPKC, Karachi during the time of incident.

1.9. Communications

1.9.1. Communication frequencies for OPKC, Karachi are provided below: -

Service designation	Call sign	Frequency	Hours of operation	Remarks
TWR	KARACHI Tower	118.3 MHZ	H24	Primary
		118.8 MHZ	H24	Secondary
		121.5 MHZ	H24	Emergency
APRON	Karachi Ground	121.6 MHZ	H24	Primary
		118.4 MHZ	H24	Secondary
		121.8 MHZ	H24	Vehicle
		123.0 MHZ	H24	
ATIS	ATIS	126.7 MHZ	H24	
APP	Karachi APP	125.5 MHZ	H24	Primary
		121.3 MHZ	H24	Secondary
		121.5 MHZ	H24	Emergency
BS	Radio	830 KHZ	HX	0130-1900 HR
BS	Pakistan	1450 KHZ	HX	Variable SKED

Table 6 Communication & Radio Navigational Aids OPKC, Karachi

1.9.2. There was no abnormality reported regarding Communication frequencies at OPKC, Karachi during the time of incident.

1.10. Aerodrome Information

1.10.1. Aerodrome data of OPKC, Karachi is provided below: -

Designations RWY NR	True bearing	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY
1	2	3	4	5	6
07L	074.29	3200 x 46	54/R/C/X/U CONCRETE ACFT upto A310 are permitted	245416.90N	THR23.50M/77FT
25R	254.29			0670851.02E	
07R	074.29	3400 x 45	87/R/B/W/T CONCRETE SWY bitumen	245402.15N	THR21.62M / 71FT
25L	254.29			0670833.56E	
				245431.79N	THR27.25M / 89FT
				0671030.20E	
Designations RWY NR	Slope of RWY/SWY	SWY dimension (M)	CWY dimension (M)	Strip dimension (M)	Obstacle Free Zone
7	8	9	10	11	12
07L	0.2% UP	305 x 46	914	3930 x 300	-
25R		305 x 46	580	3930 x 300	
07R	0.168% UP	305 x 45	870x150	4126 x 300	-
25L		301 x 45	483X150	4126 x 300	

Table 7 Aerodrome Information OPKC, Karachi

1.10.2. There was no abnormality reported regarding Aerodrome Operations at OPKC, Karachi during the time of incident.

1.11. Flight Recorders

1.11.1. Not Applicable.

1.12. Wreckage and Impact Information

1.12.1. Not Applicable.

1.13. Medical and Pathological Information

1.13.1. Not Applicable.

1.14. Fire

1.14.1. Not Applicable.

1.15. Survival Aspects

1.15.1. Not Applicable.

1.16. Test and Research

1.16.1. Not Applicable.

1.17. Organizational and Management Information

1.17.1. Not Applicable.

1.18. Additional Information

1.18.1. **TCAS Working Principle** – TCAS stands for Traffic alert and Collision Avoidance System, and its purpose is to minimize the risk of mid-air collisions between aircraft. Working independently from Air Traffic Control, TCAS uses nearby aircraft’s transponder signals to alert pilots to the danger of mid-air collisions. It does so by constructing a three-dimensional map of airspace through which the aircraft is travelling. In detecting the other aircraft’s transponder signals, it can foresee the potential collisions based on speeds and altitude of planes passing through the airspace in question. If TCAS detects a potential collision, it will automatically notify each of the affected aircraft. In this instance, it will automatically initiate a mutual avoidance manoeuvre. This involves the system informing the crews of the aircraft in question both audibly and visibly to either climb or descend in a manner that ensures that, when their paths cross, they do not meet.

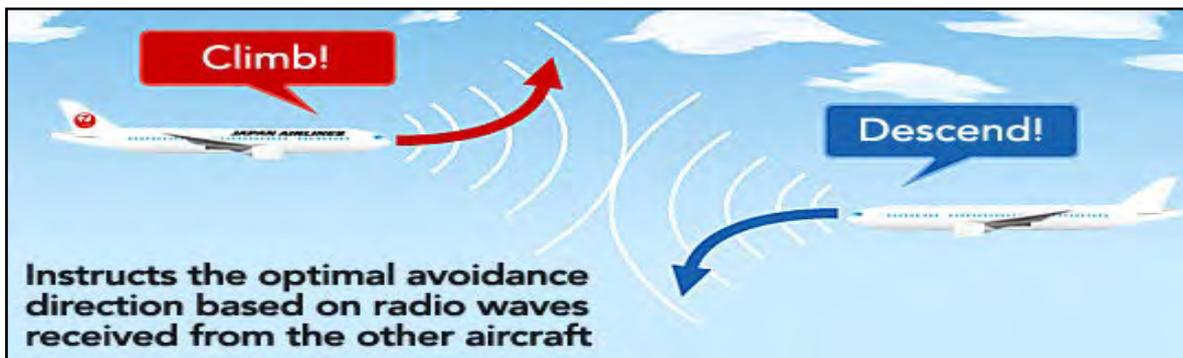


Figure 5 TCAS Alert

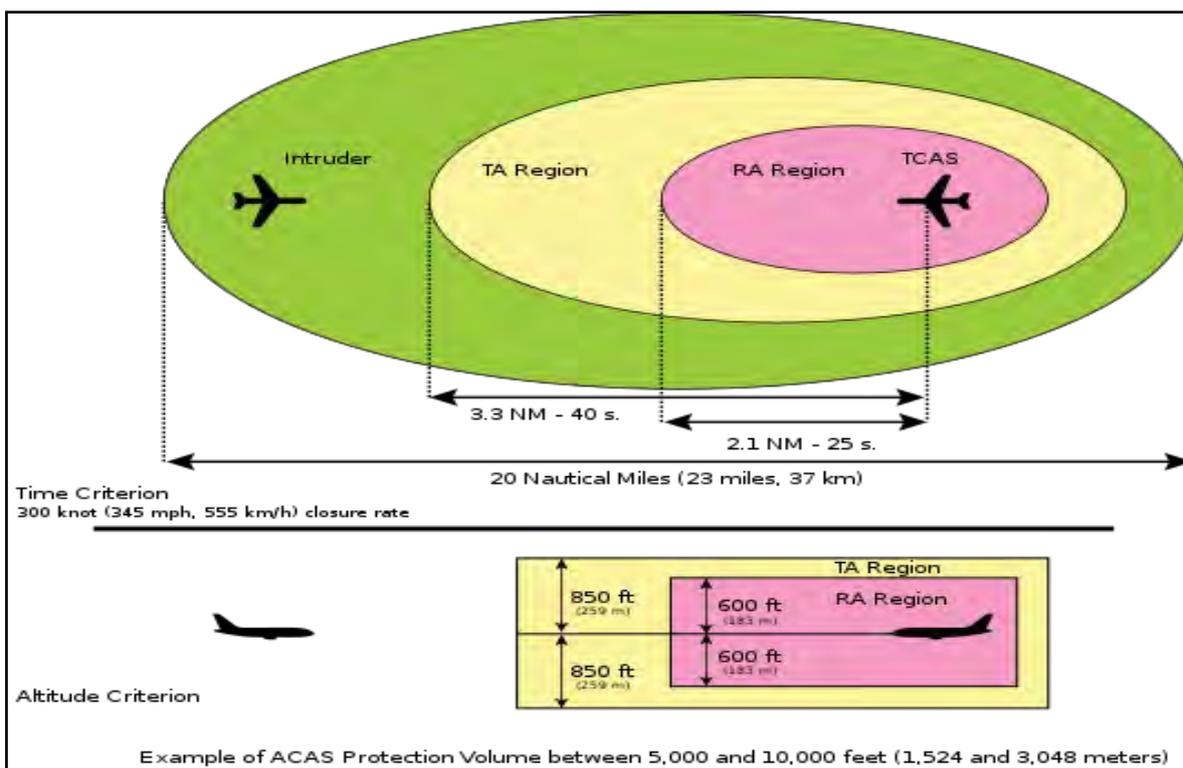


Figure 6 TCAS TA & RA ranges

1.18.2. **Traffic Display Symbology** – On the TCAS traffic display both colour and shape are used to assist the pilot in interpreting the displayed information.

1.18.2.1. Own-aircraft is depicted as a white or yellow aircraft-like symbol. Targets are displayed by different symbols, according to their threat status

1.18.2.2. Hollow white diamond – for other traffic. (No threat).

1.18.2.3. Solid white diamond – for proximate traffic.

1.18.2.4. Solid yellow or amber circle – for intruders (i.e. aircraft which trigger a TA).

1.18.2.5. Solid red square – for threats (i.e. aircraft which trigger an RA).



Figure 7 Traffic Display

1.19. Useful & Effective Investigation Techniques

1.19.1. Standard investigation procedures and techniques were used during the course of investigation.

SECTION 2 – ANALYSIS

2.1. General

2.1.1. Emirates flight UAE600, Boeing 777-31H(ER) aircraft, Reg. No. A6-ENK was a schedule passenger flight which took-off from OMDB, Dubai, UAE to OPKC, Karachi, Pakistan.

2.1.2. UAE600 came in contacted Karachi Approach passing FL254 for FL150 direct to BEGIM and was further given descend to FL110 by Approach Controller.

2.1.3. Later, UAE600 was re-cleared to descend FL140, and advised to expect lower level after 03 min by Approach Controller due to Military formation at FL120 as informed by MMR Planner.

2.1.4. Military traffic, a Formation of 02 x Mirage Military aircraft (ARCHER-1 & ARCHER-2) was operating in Karachi Control Zone and carrying out Instrument Let Down at OPMR from a coordinated flight level (FL120) and was in contact with MMR.

2.1.5. At 05:50:06 h, UAE600 reported traffic at 3 o'clock (which was actually 10 o'clock) just 200 ft below, upon which Approach Controller informed UAE600 about the Military traffic maintaining FL120, crossing from left to right whereas Military traffic was passing through FL141 for higher although it was restricted to FL120.

2.1.6. At 05:50:17 h, UAE600, reported and initiated TCAS – RA climb and after a short while reported “traffic insight and clear of conflict.”

2.1.7. After confirmation from MMR, Approach Controller informed UAE600 that Military traffic was maintaining FL120. However, aircrew of UAE600 insisted that Military traffic was visually identified at 200 ft separation. This information was relayed to MMR, which re-confirmed that Military fighters maintained FL120 throughout (until their inbound decent commenced).

2.1.8. At the time of incident, minimum vertical separation of 200 ft and lateral 6.3 NM existed between UAE600 and ARCHER-2 Military aircraft.

2.1.9. As per the available record, ARCHER-2 climbed to FL149 from FL133 while approaching close to UAE600 on a crossing track. UAE600 was also crossing FL 149 while initiating RA climb to higher level, which may have resulted in activation of TCAS – RA.

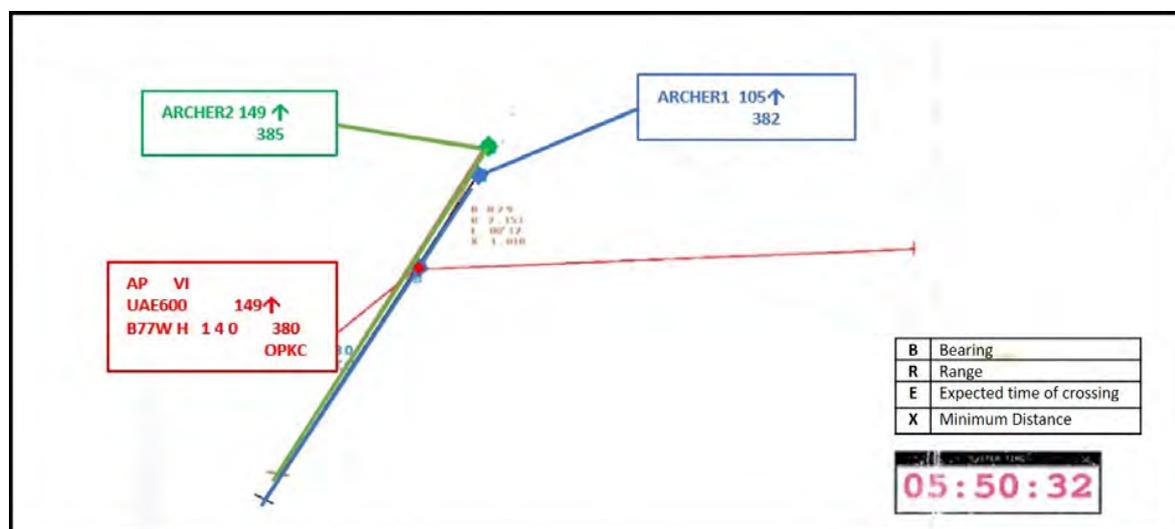


Figure 8 Traffic insight and clear of conflict

2.1.10. UAE600 climbed up to FL155 in response to TCAS – RA.

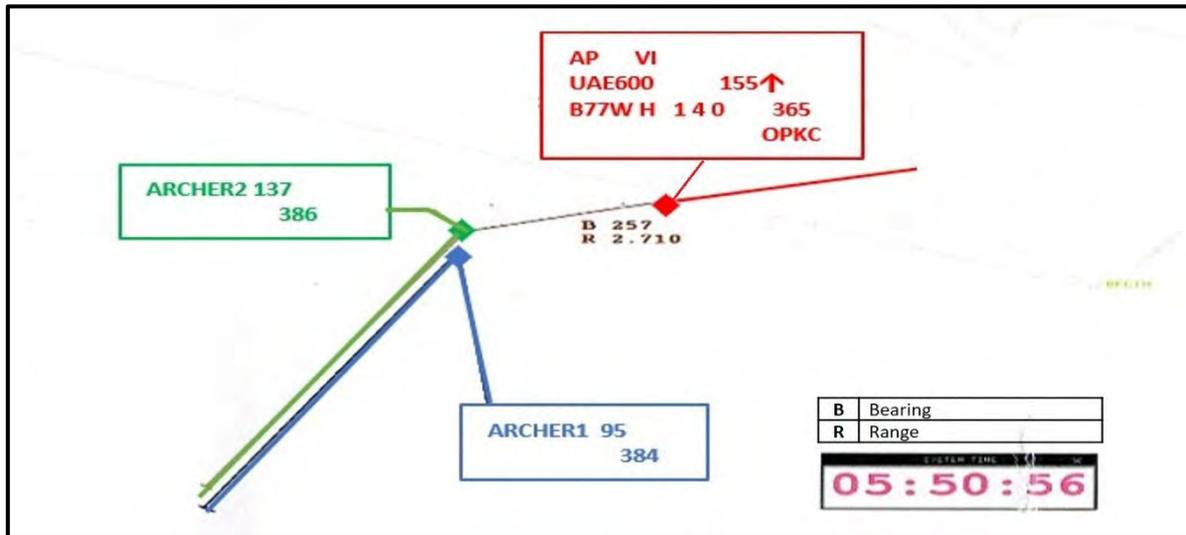


Figure 9 Climbed up to FL155 in response to TCAS – RA

2.1.11. MMR informed that both military aircraft reported maintaining FL120 throughout and this might be due to false Mode C indication.

2.1.12. Although both PCAA Approach Controller and MMR Controllers were using same Radar Data on their scopes but they failed to notice / verify wrong Mode C indication of ARCHER-2 till the time UAE600 reported TCAS – RA.

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SECTION 3 – CONCLUSIONS

3.1. Findings

- 3.1.1. Emirates flight UAE600 operated from OMDB to OPKC. Weather at Karachi was Hazy.
- 3.1.2. When in contact with Approach Controller, UAE600 was given descend to FL110 while passing FL254 for FL150.
- 3.1.3. UAE600 was re-cleared to descend FL140 and was advised to expect lower level after 03 min due to Military formation at FL120 as informed by MMR Planner. At this time, no traffic information was passed to UAE600 about Military aircraft.
- 3.1.4. PAF formation (ARCHER-1 & ARCHER-2) was carrying out Instrument Let Down at OPMR within Karachi Control Zone and was in contact with MMR.
- 3.1.5. Approach Controller observed ARCHER-2 at FL137 on Radar before crossing Masroor NDB.
- 3.1.6. Approach Controller did not verify the level discrepancy of Military aircraft from MMR.
- 3.1.7. UAE600 reported traffic at 3 o'clock (which was actually 10 o'clock) 200 ft below, upon which Approach Controller informed UAE600 about the Military traffic maintaining FL120, crossing from left to right.
- 3.1.8. UAE600, reported and initiated TCAS – RA climb up to FL155 and reported “traffic insight and clear of conflict.”
- 3.1.9. At the time of incident, minimum vertical separation of 200 ft and lateral separation of 6.3 NM existed between UAE600 and ARCHER-2 (Military aircraft).
- 3.1.10. As per the Approach Radar screenshots, ARCHER-2 also climbed to FL149 from FL133 while approaching close to UAE600 on a crossing track.
- 3.1.11. MMR informed that both Military aircraft reported maintaining FL120 throughout and this might be due to false Mode C indication.
- 3.1.12. Although Both PCAA Approach and MMR Controllers were using same Radar Data on their respective scopes but both failed to notice and did not verify ARCHER-2 altitude disparity till the activation of TCAS – RA alert reported by UAE600.

3.2. Cause / Contributory Factors

3.2.1. Cause

- 3.2.1.1. Activation of TCAS – RA (**MAC – Mid Air Collision**) due to non maintenance of designated flight level by Military aircraft.

3.2.2. Contributory Factors

- 3.2.2.1. Failure to timely recognise altitude discrepancy of Military aircraft both by Civil as well as MMR controller.

Note: *Aviation Occurrence Category (ADREP Taxonomy)*
“Mid-Air Collision (MAC): Separation-related occurrences caused by either air traffic control or cockpit crew

SECTION 4 – SAFETY RECOMMENDATIONS

4.1. Safety Recommendations

4.1.1. Air Traffic Controllers are advised to remain vigilant and any ambiguity must be verified.

4.1.2. Adherence of altitude maintenance by all aircraft would avoid similar recurrences in future.

4.1.3. Serviceability and reliability of all onboard avionics equipment on aircraft and Radar would ensure safe air operations.