

FINAL INVESTIGATION REPORT



**SERIOUS INCIDENT (TCAS – RA) – AIR ARABIA FLIGHT
ABY531, AIRBUS 320 AIRCRAFT, REG NO. A6-ANS
(KATMANDU – SHARJAH) & SPICEJET, FLIGHT
SEJ711, BOEING 737 AIRCRAFT, REG NO. VT-MXK,
(DUBAI – INDORE) ON 15-01-2022**

SCOPE

At Bureau of Aircraft Safety Investigation (BASI), Pakistan investigations are conducted in accordance with Annex-13 to the International Civil Aviation Organization (ICAO) Convention on International Civil Aviation and Civil Aviation Rules 1994 (CARs 94).

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
ACC	Area Control Centre
ASR	Air Safety Report
ATC	Air Traffic Control
ATS	Air Traffic Services
BEA	Bureau of Enquiry and Analysis
CARs	Civil Aviation Rules
FCTM	Flight Crew Training Manual
FIR	Flight Information Region
FL	Flight Level
ft	Feet
GCAA	General Civil Aviation Authority
h	Hour(s)
HVR	High Vertical Rate
ICAO	International Civil Aviation Organization
IOU	Incident Occurrence and Unserviceability Report
kt	Knot(s)
MAC	Mid Air Collision
MET	Metrological
min	Minute(s)
NM	Nautical Miles
NTSB	National Transportation and Safety Board
OMDB	Dubai International Airport (ICAO Code)
OMSJ	Sharjah International Airport (ICAO Code)
PCAA	Pakistan Civil Aviation Authority
RA	Resolution Advisory
ROC	Rate of Climb
TA	Traffic Advisory
TCAS	Traffic Alert and Collision Avoidance System
UAE	United Arab Emirates
UTC	Universal Time Coordinated
VAID	Devi Ahilya Bai Holkar Airport (ICAO Code)
VNKT	Tribhuvan International Airport (ICAO Code)

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 and through Air Safety Report (ASR)² raised by Air Arabia. Ministry of Aviation, Government of Pakistan issued Memorandum and Corrigendum³ issued by BASI, Pakistan to investigate the serious incident. This serious incident was notified⁴ to International Civil Aviation Authority (ICAO), General Civil Aviation Authority (GCAA), National Transportation and Safety Board (NTSB), Aircraft Accident Investigation Bureau (AAIB), India and Bureau of Enquiry and Analysis (BEA), France in line with Annex-13. The investigation has been conducted by BASI, Pakistan. All corresponding timings are mentioned in Universal Coordinated Time (UTC).

¹ PCAA IOU Report dated 15th January, 2022

² Air Arabia Air Safety Report (ASR) No. 20803 dated 15th January, 2022

³ Ministry of Aviation Memorandum No. HQCAA/1902/003/TCAS/Inv dated 25th March, 2022 & BASIP Corrigendum No. AAIB/1902/003/TCAS/Inv

⁴ Initial Notification to ICAO dated 2nd March, 2022

SYNOPSIS

On 15th January, 2022, Air Arabia flight ABY531, Airbus 320 aircraft, Reg. No. A6-ANS took off from Tribhuvan International Airport (VNKT), Kathmandu, Nepal for Sharjah International Airport (OMSJ), Sharjah, United Arab Emirates (UAE) on Air Traffic Services (ATS) route MERUN-RK-LUBNA-G214-SK-G214-BIVIN.

SpiceJet SEJ711, Boeing 737 aircraft, Reg. No. VT-MXK, was operating from Dubai International Airport (OMDB), Dubai, UAE to Devi Ahilya Bai Holkar Airport (VAID), Indore, India on route ASVIB-G665-PG-G214-MOLTA-G214-LA-A456-AAR. Both were scheduled transit passenger flights.

ABY531 was cleared from LUBNA direct to position IDEBA maintaining FL320 and SEJ711 was cleared from position ASVIB to IDEBA maintaining FL350.

While approaching IDEBA, ABY531 requested climb to FL340 which was approved by Air Traffic Control (ATC). When ABY531 was overhead IDEBA passing FL335 for FL340, it reported Traffic alert and Collision Avoidance System – Resolution Advisory (TCAS – RA) and stopped climb at FL335. At that time reciprocal traffic SEJ711 was 05 Nautical Mile (NM) at FL350. Upon obtaining confirmation from SEJ711 by ATC Controller, pilot reported TCAS – Traffic Advisory (TA) only, due high Rate of Climb (ROC) of reciprocal traffic.

At the time of occurrence both aircraft were in contact with Area Control Centre (ACC), Karachi (West) and under positive radar coverage. After getting clear from reciprocal traffic, ABY531 resumed its climb to FL340. Upon query by Team Leader ACC Karachi, ABY531 admitted that it was maintaining **high ROC due moderate to severe turbulence**. Vertical separation of 1,500 ft existed between both the aircraft at the time of activation of TCAS – RA however, standard separation was not infringed.

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SECTION 1 - FACTUAL INFORMATION

1.1. History of the Flight

1.1.1. On 15th January, 2022, Air Arabia flight ABY531 was a commercial passenger flight which took off from VNKT, Kathmandu, Nepal for OMSJ, Sharjah, UAE on Air Traffic Services ATS route MERUN-RK-LUBNA-G214-OPSK-IDEBA-OPPG-G214-BIVIN.

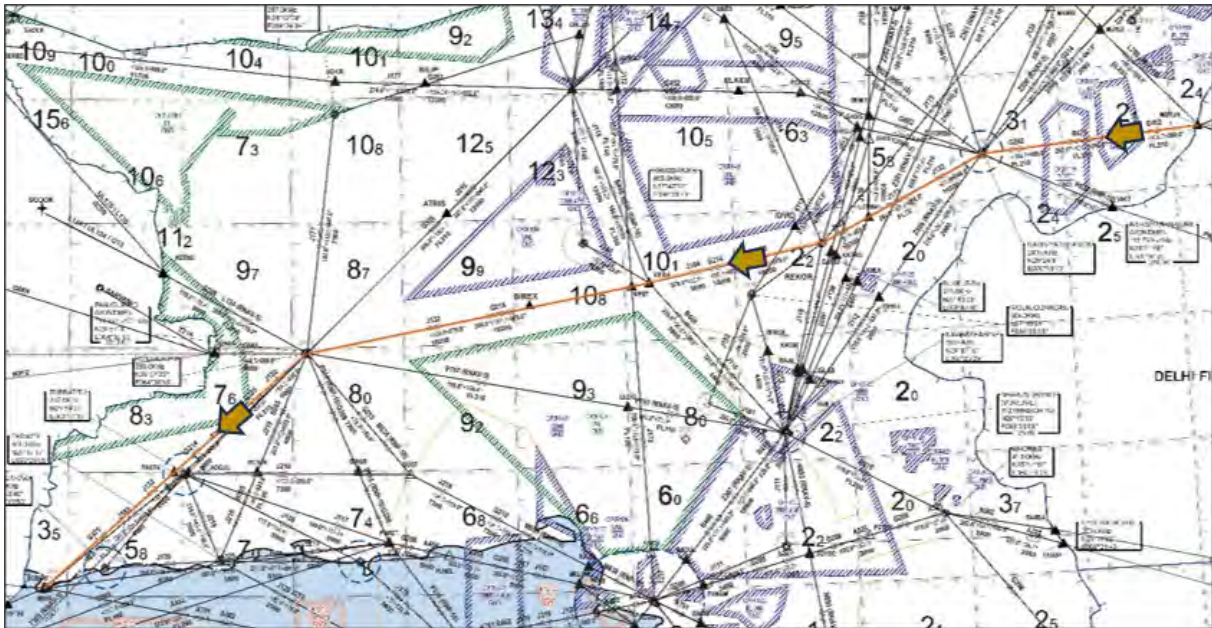


Figure 1 ABY531 Route

1.1.2. SpiceJet flight SEJ711 was operating from OMDB, Dubai, UAE to VAID, Indore, India on route ASVIB-G665-PG-G214-MOLTA-G214-LA-A456-AAR.

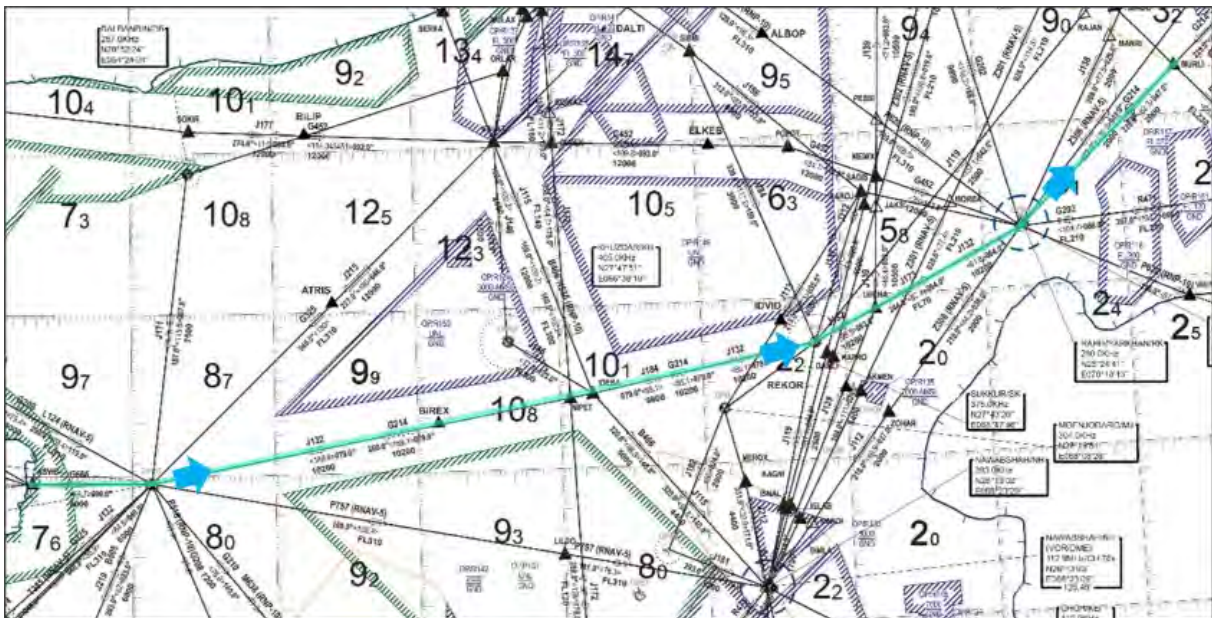


Figure 2 SEJ711 Route

1.1.3. ABY531 and SEJ711 were scheduled transit passenger flights and both aircraft were in contact with ACC Karachi (West) under positive radar coverage.

1.1.4. ABY531 was cleared from LUBNA direct to IDEBA maintaining FL320 and SEJ711 was cleared from ASVIB to IDEBA maintaining FL350.

1.1.5. While approaching IDEBA, ABY531 requested climb to FL340 which was approved by ATC.

1.1.6. When ABY531 was overhead IDEBA passing FL335 for FL340, it reported TCAS – RA and stopped climb at FL335.



Figure 3 - ABY531 Approaching position IDEBA (6.5 NM reciprocal)

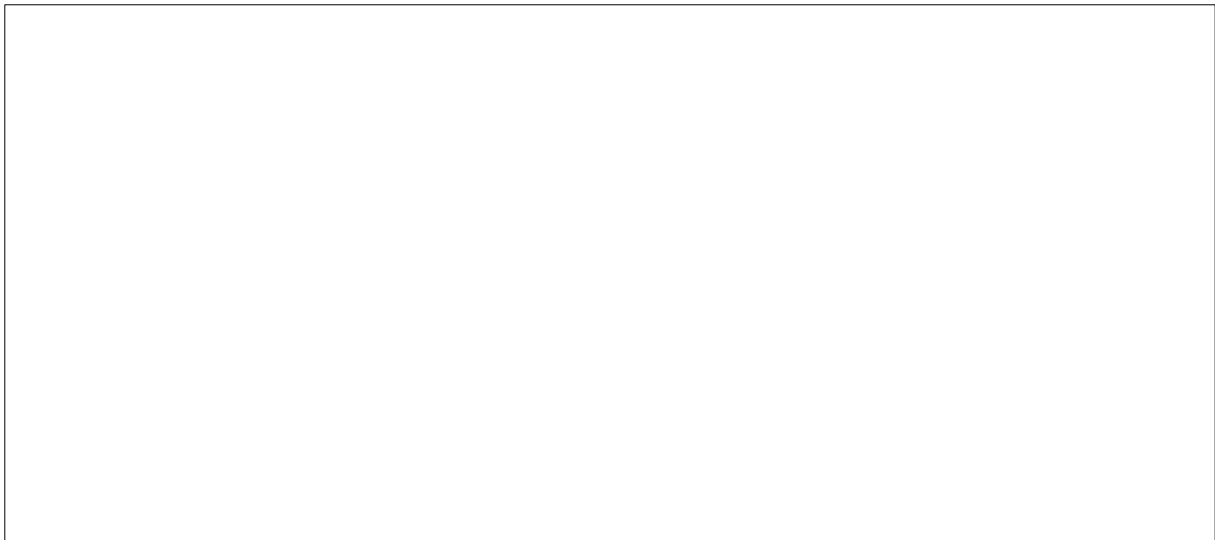


Figure 4 - ABY531 maintaining FL335 after crossing position IDEBA

1.1.7. At the time of RA, reciprocal traffic SEJ711 was 05 NM at FL350. On confirmation from SEJ711, pilot reported TCAS – TA only due high ROC of reciprocal traffic. ABY531 resumed its climb to FL340.

1.1.8. Upon query by Team Leader ACC Karachi, ABY531 admitted that it was maintaining high ROC due moderate to severe turbulence.

1.1.9. At the time of RA, 1,500 ft vertical separation existed between the two aircraft and standard separation was not infringed.

1.1.10. Both aircraft continued to their 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.

1.3. Damage to Aircraft

1.3.1. At the time of occurrence there was no damage reported 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

ABY531	
Aircraft Make & Model	Airbus 320-214
Registration Marking	A6-ANS
Manufacturer Serial No.	5772
Year of Manufacturer	2013
Operator	Air Arabia
Sector	Kathmandu to Sharjah

Table 1 Aircraft details – ABY531

SEJ711	
Aircraft Make & Model	Boeing 737-8 MAX
Registration Marking	VT-MXK
Manufacturer Serial No.	60224
Year of Manufacturer	2019
Operator	SpiceJet
Sector	Dubai to Indore

Table 2 Aircraft details – SEJ711

1.7. Meteorological Information

1.7.1. As per the forecasted significant weather charts⁵ reported by Pakistan Meteorological Department, a strong Jet Stream was present centred at FL370, which may have caused turbulence / wind shear along the route Rahim Yar Khan – Sukkur – IDEBA – Panjgur.

1.8. Aids to Navigation

1.8.1. Not Applicable.

1.9. Communications

1.9.1. Communication frequencies for Karachi Flight Information Region (FIR) are provided below. At the time of incident, no abnormality was reported. (also include ENR 3.1 ATS route)

⁵ Pakistan Meteorological Department Weather Report dated 14th and 15th January, 2022

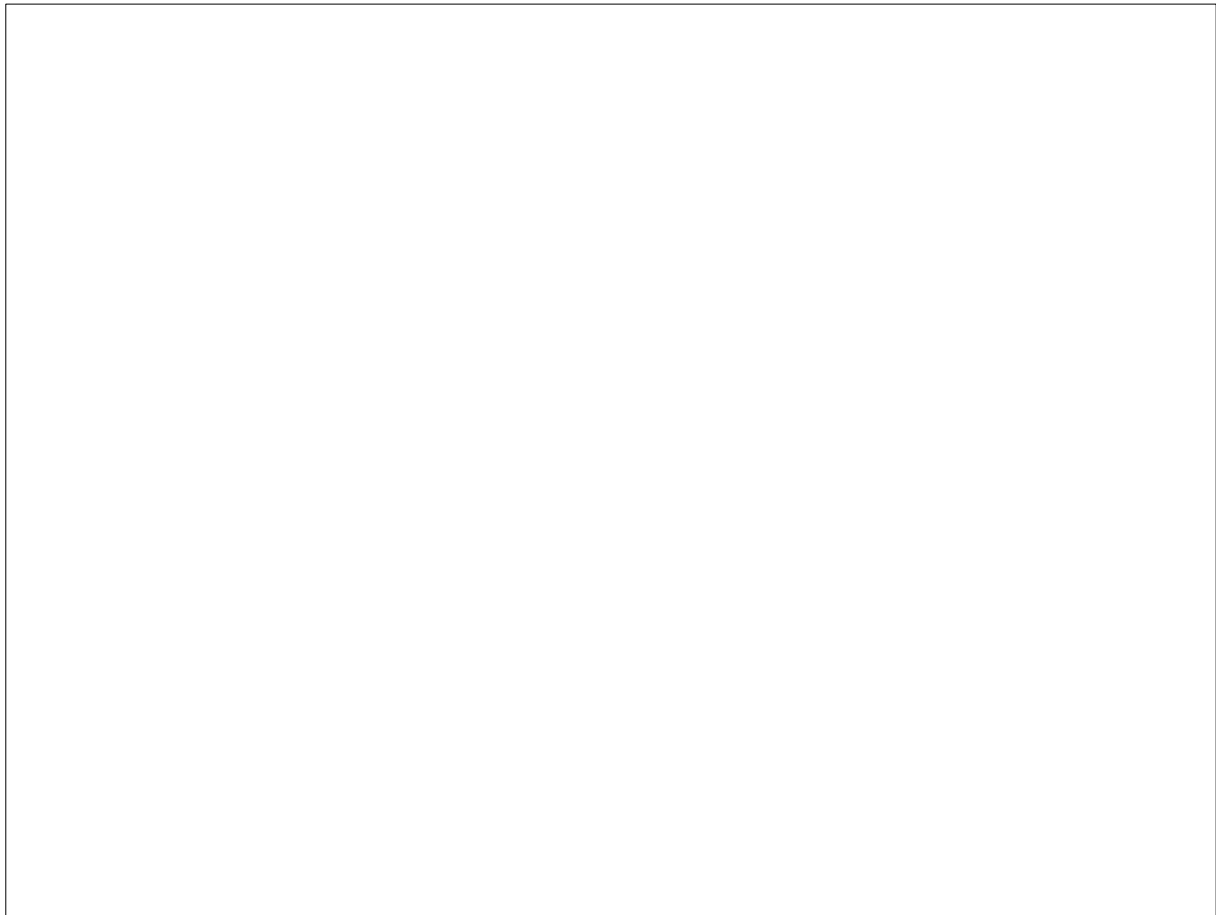


Table 3 Communication Frequencies for Karachi FIR

Route designator Name of significant points COORD	Magnetic Track Distances (NM)	Upper limits Lower Limits. Airspace classification	Lateral limits NM	Direction of cruising levels		RMK Controlling unit FREQ
				Odd	Even	
1	2	3	4	5		6
G214						
▲ BIVIN 250350N 0614744E	046° 227° 83.7NM	UNL 6000 FT Class A at or above FL 155 Class G below FL 155.	20	↓	↑	To establish contact at least 15 minutes prior to entering FIR. Karachi ACC South Pri FREQ 133.025MHZ Sec FREQ 121.950MHZ
▲ PASTA 260000N 0625633E	047° 228° 85.9NM	UNL 6000 FT Class A at or above FL 155 Class G below FL 155	20	↓	↑	Karachi ACC West Pri FREQ 128.350MHZ Sec FREQ 121.650MHZ
▲ PANJGUR VOR/DME (PG) 265710N 0640813E	078° 258° 103.9NM	UNL 10200 FT Class A at or above FL 155 Class G below FL 155	20	↓	↑	
▲ BIREX 271624N 0660236E	078° 259° 64.2NM	UNL 10200 FT Class A at or above FL 155 Class G at or below FL 155	20	↓	↑	Karachi ACC Centre Pri FREQ: 122.050 Mhz Sec FREQ: 133.625 Mhz

Table 4 Routes and Frequencies of Karachi FIR

Route designator Name of significant points COORD	Magnetic Track Distances (NM)	Upper limits Lower Limits. Airspace classification	Lateral limits NM	Direction of cruising levels		RMK Controlling unit FREQ
				Odd	Even	
1	2	3	4	5		6
▲ IDEBA 272730N 0671338E	077° 258° 85.1NM	UNL 10200 FT Class A at or above FL 155 Class G below FL 155	20	↓	↑	
▲ SUKKUR NDB (SK) 274320N 0684746E	061° 242° 25.5NM	UNL 10200 FT Class A at or above FL 155 Class G below FL 155	20	↓	↑	Lahore ACC South Pri FREQ 123.150MHZ Sec FREQ 132.950MHZ
▲ LUBNA 275447N 0691332E	062° 243° 61.8NM	UNL 10200 FT Class A at or above FL 155 Class G below FL 155	20	↓	↑	
▲ RAHIM YAR KHAN VOR/DME (RK) 282156N 0701623E	046° 226° 82.3NM	UNL 2000 FT Class A at or above FL 155 Class G below FL 155 Class C below FL 75, 10NM around RK	20	↓	↑	
▲ MIRLI	047°	UNL	20			All ACFT below FL 70 on OPRK/

Table 5 Routes and Frequencies of Karachi FIR

1.10. Aerodrome Information

1.10.1. Not Applicable.

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 (TA) alert

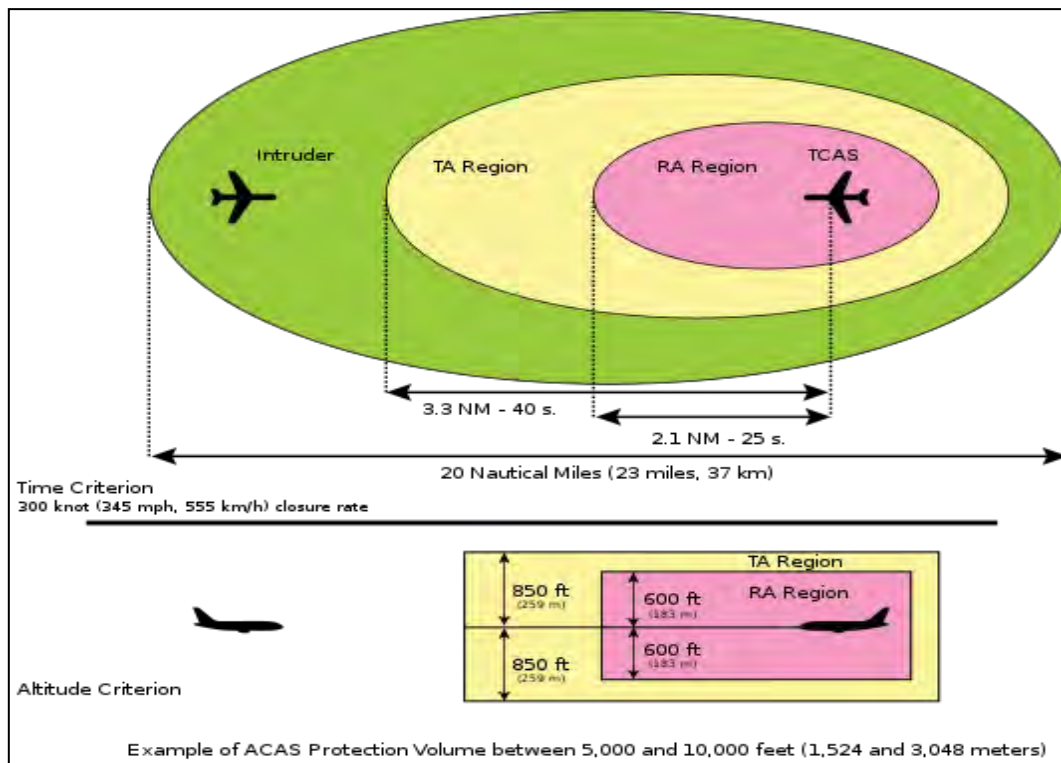


Figure 6 TCAS TA & RA ranges

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 or Effective Investigation Techniques

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

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SECTION 2 – ANALYSIS

2.1. General

2.1.1. On 15th January, 2022, Air Arabia flight ABY531 was a commercial passenger flight operating from VNKT, Katmandu, Nepal to OMSJ, Sharjah, UAE on ATS route MERUN-RK-LUBNA-G214-SK-G214-BIVIN.

2.1.2. SpiceJet flight SEJ711 took off from OMDH, Dubai, UAE to VAID, Indore, India on route ASVIB-G665-PG-G214-MOLTA-G214-LA-A456-AAR.

2.1.3. ABY531 and SEJ711 were in contact with ACC Karachi (West) under positive radar coverage.

2.1.4. As per weather charts⁶ reported by Pakistan Meteorological Department, a strong Jet Stream was present centred at FL370, which could cause turbulence / wind shear along the route Rahim Yar Khan- Sukkur – IDEBA – Punjgur.

2.1.5. At 08:20:08 hours (h), SEJ711 came into contact with ACC Karachi (West) approaching ASVIB maintaining FL350.

2.1.6. At 08:20:14 h, ACC Karachi (West) identified SEJ711 and cleared the aircraft from ASVIB to IDEBA direct.

2.1.7. At 08:26:40 h, ABY531 came in contact ACC Karachi (West) after crossing position LUBNA. ABY531 was maintaining FL320 and was cleared direct to IDEBA.

2.1.8. At 08:41:30 h, ABY531 requested climb to FL340, which was approved by ACC Karachi West.

2.1.9. At time 08:41:43 h (as per RT extracts) / 08:42:05 (as per radar screen shot) ABY531 left FL320 for FL340.

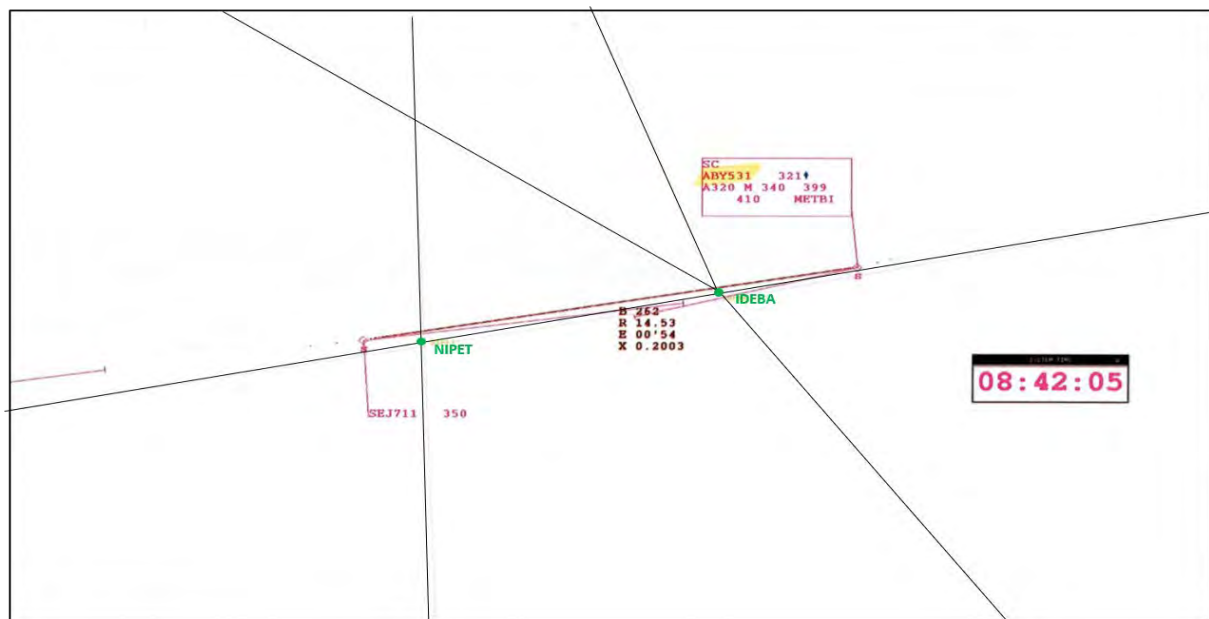


Figure 8 - ABY531 reporting TCAS - RA

2.1.10. At 08:42:00 h, when ABY531 was overhead IDEBA passing FL335 for FL340, it reported TCAS – RA and stopped climb at FL335.

⁶ Pakistan Meteorological Department – Weather Charts dated 15-01-2022

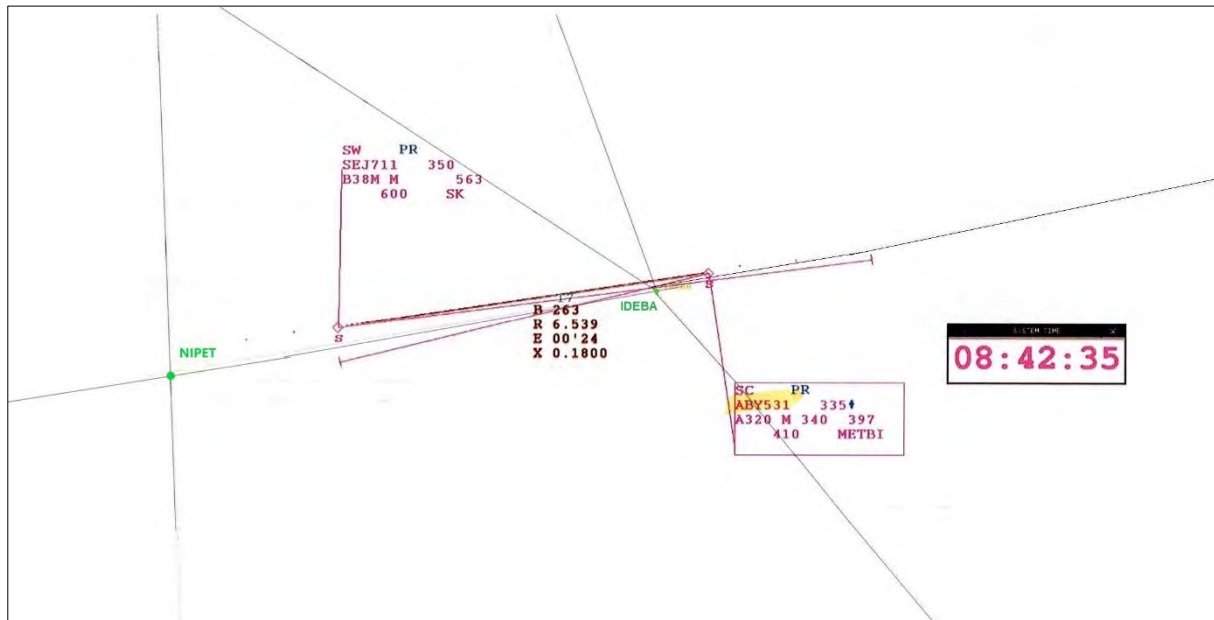


Figure 9 - ABY531 maintaining FL335

2.1.11. At the time of RA, reciprocal traffic SEJ711 was separated by 05 NM⁷ at FL350. Once inquired from SEJ711, pilot reported TCAS –TA only, due to high ROC of reciprocal traffic. On confirmation from SEJ711, ABY531 resumed its climb to FL340.

2.1.12. At 08:43:40 h, ABY531 again informed ATC that it had TCAS – RA and climbing FL340.

2.1.13. At 08:43:51 h, ABY531 inquired about the traffic at FL350 over position IDEBA. ACC Karachi (West) passed the traffic information about SEJ711 which was operating at FL350 reciprocal to ABY531.

2.1.14. At time 08:44:34 h, ABY531 reported clear of conflict and maintaining FL340.

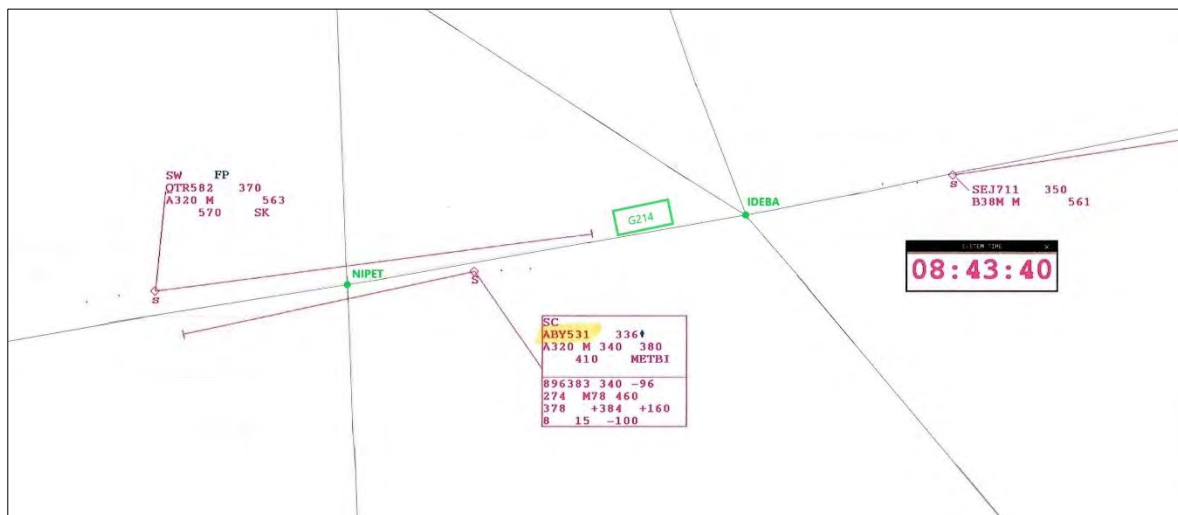


Figure 10 - ABY531 reporting clear of conflict

2.1.15. At 09:02:17 h, Team Leader ACC Karachi inquired from ABY531 regarding TCAS – RA activation with ROC more than 3,000 ft / min during last 1,000 ft of climb. ABY531 admitted that it was maintaining high ROC due moderate to severe turbulence and once approaching FL340, reciprocal traffic was seen on screen; prior to that the pilot did not observe any traffic.

⁷ Radar West and Planner West Controllers statements

2.1.16. At time 09:19:35 h, ABY531 further informed that it had increased the ROC due moderate to severe turbulence until climb to FL330 and that it did not have information about traffic at FL350.

2.1.17. ABY531 was maintaining high ROC Approx 3,600 ft / min which was contrary to ICAO Doc 8168 Vol-III, which states: -

“3.3 HIGH VERTICAL RATE (HVR) ENCOUNTERS

Pilots should use appropriate procedures by which an aeroplane climbing or descending to an assigned altitude or flight level, especially with an autopilot engaged, may do so at a rate less than 8 m/s (or 1,500 ft / min) throughout the last 300 m (or 1,000 ft) of climb or descent to the assigned altitude or flight level when the pilot is made aware of another aircraft at or approaching an adjacent altitude or flight level, unless otherwise instructed by ATC. Some aircraft have auto-flight systems with the capability to detect the presence of such aircraft and adjust their vertical rate accordingly. These procedures are intended to avoid unnecessary ACAS II resolution advisories in aircraft at or approaching adjacent altitudes or flight levels. For commercial operations, these procedures should be specified by the operator”

2.1.18. **Meteorological Factors:** As the aircraft climbed from FL320 to FL340, the head wind increased from 50 kt to 80 kt. The contribution of this increase in wind to the vertical speed of climb is as follows: -

2.1.18.1. The data obtained shows a headwind increase of ~30 kt during the climb.

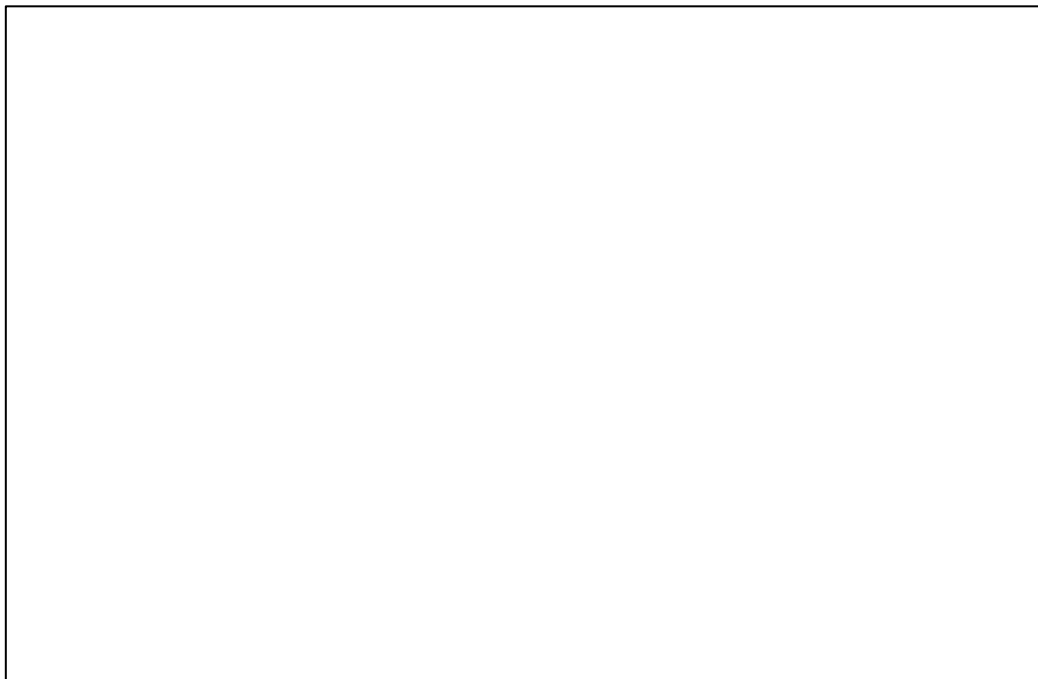


Figure 11 – Head Wind Data

2.1.18.2. The effect of the increase in headwind resulted in an increase in vertical speed is as shown below: -



Figure 12 – Vertical Speed Data

2.1.18.3. Without an increase in headwind, the vertical speed would have reached 1,700 ft/min whereas with the increase in headwind during the climb, the vertical speed reached 3,600 ft/min. The vertical profiles with both vertical speeds are as shown: -

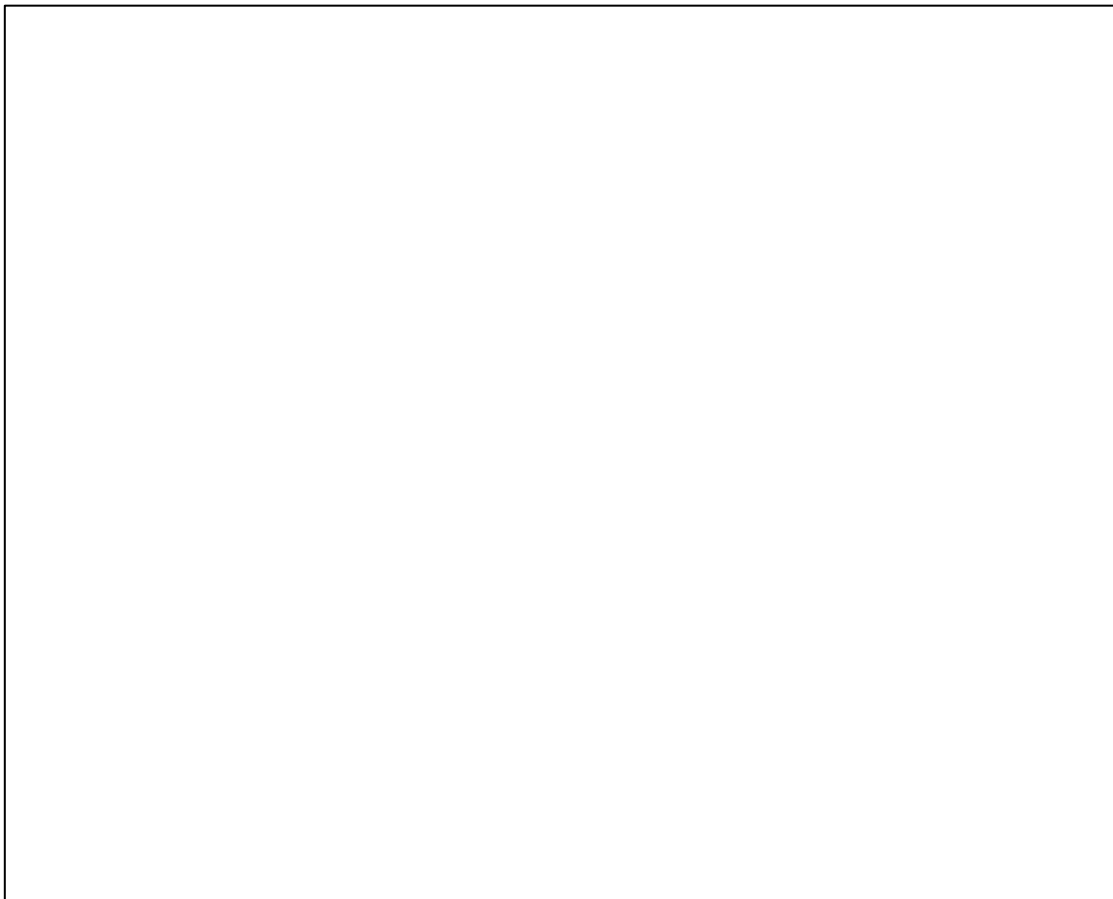


Figure 13 – Vertical Profile and Vertical Speed

2.1.18.4. The analysis shows that the increase in headwind increased the vertical speed of the aircraft. this meant that at the time of the TCAS-RA, the aircraft was 625 ft higher and climbing at a speed 1,900 ft/min faster than a climb profile with no headwind increase. Without the headwind increase, the climb rate would have been ~1,700 ft/min.

2.1.18.5. The TA and RA alerts as a result of prevailing circumstances is shown as follows: -



Figure 14 – TA and RA Alerts

2.1.18.6. A TCAS simulation performed to establish whether TCAS-RA would have triggered at a nominal 1,700 ft/min climb rate indicates that at this climb rate, only a TCAS-TA would have triggered and not a TCAS-RA:-

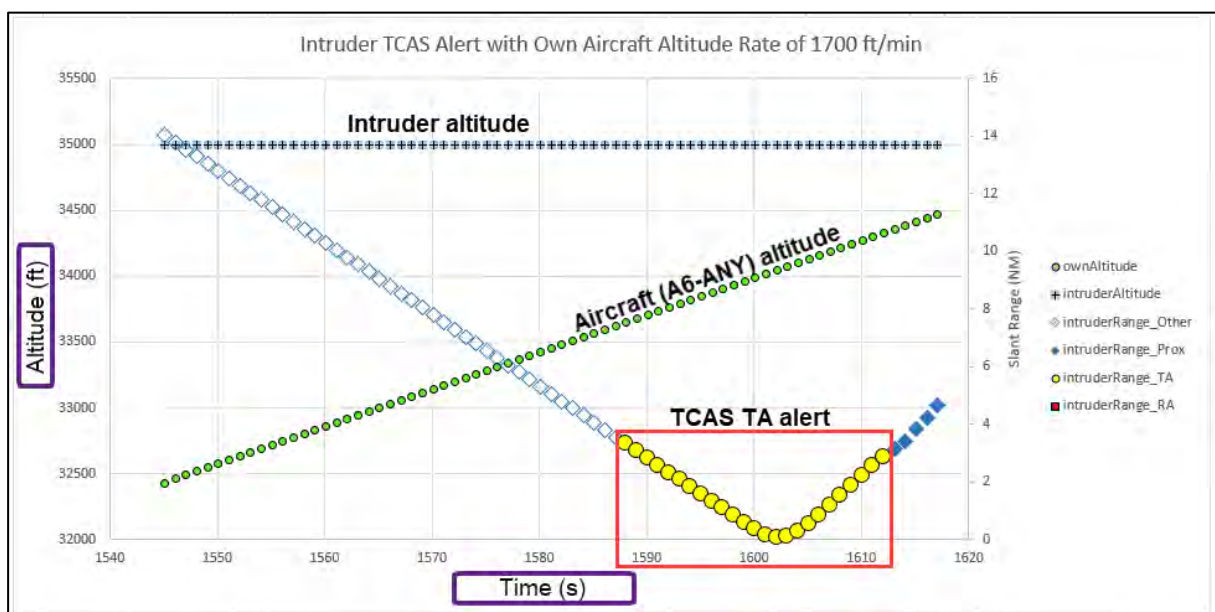


Figure 15 – TCAS Simulation

2.1.18.7. **Operational considerations:** As per the Flight Crew Techniques Manual (FCTM), flight crew should monitor the climb speed during the last 2,000 ft of altitude capture and limit it to 1,500 ft/min to avoid similar TCAS-RA alerts.

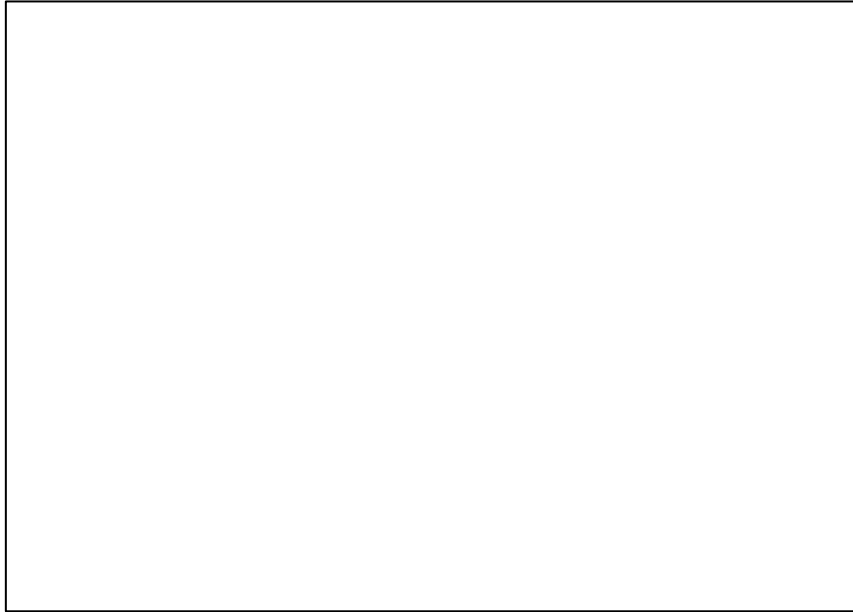


Figure 16 – Air Arabia FCTM

2.1.19. At the time of RA, 1,500 ft vertical separation existed between the two aircraft and standard separation was not infringed.

2.1.20. Both aircraft continued to their destination without any further incident.

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SECTION 3 – FINDINGS

3.1. Findings

3.1.1. On 15th January, 2022, ABY531 was a commercial passenger flight operating from VNKT, Katmandu Nepal to OMSJ, Sharjah, UAE on ATS route MERUN-RK-LUBNA-G214-SK-G214-BIVIN.

3.1.2. SpiceJet flight SEJ711 was operating from OMDH, Dubai UAE to VAID, Indore, India on route ASVIB-G665-PG-G214-MOLTA-G214-LA-A456-AAR.

3.1.3. ABY531 and SEJ711 were scheduled transit passenger flights and both aircraft were in contact with ACC Karachi (West) under positive radar coverage.

3.1.4. As per the weather charts issued by Pakistan Meteorological Department, a strong Jet Stream was present at FL370, which could cause turbulence / wind shear along the route Rahim Yar Khan- Sukkur – IDEBA – Punjgur.

3.1.5. SEJ711 came in contact with ACC Karachi (West) maintaining FL350 while approaching position ASVIB. After identification, ACC Karachi (West) cleared SEJ711 from ASVIB direct to position IDEBA.

3.1.6. ABY531 came in contact ACC Karachi (West) after crossing position LUBNA. ABY531 was maintaining FL320 and was cleared direct to IDEBA.

3.1.7. When ABY531 was approximately 2-3 minutes (min) short of IDEBA, it requested climb to FL340, which was approved by ACC Karachi (West).

3.1.8. ABY531, while passing FL335 for 340 overhead IDEBA, reported TCAS – RA and stopped climb at FL335.

3.1.9. At the time of RA, reciprocal traffic SEJ711 was 05 NM at FL350. On confirmation from SEJ711, pilot reported TCAS –TA only, due high ROC of reciprocal traffic.

3.1.10. ABY531 resumed its climb to FL340.

3.1.11. ABY531 inquired about the traffic at FL350 over position IDEBA. ACC Karachi (West) passed the traffic information about SEJ711 which was operating at FL350 reciprocal to ABY531

3.1.12. Upon confirmation by ACC Karachi (West) Controller, SEJ711 reported that ABY531 was climbing at high Rate of Climb and SEJ711 only got TA at FL350.

3.1.13. ACC Karachi Team Leader inquired from ABY531 regarding TCAS-RA activation with ROC more than 3,000 ft / min during last 1,000 ft of climb. ABY531 admitted that it was maintaining high ROC due moderate to severe turbulence and once approaching FL340, reciprocal traffic was seen on screen; prior to that the pilot did not observe any traffic.

3.1.14. ABY531 further informed that it increased the ROC due moderate to severe turbulence until FL330 and also informed that it did not have information about traffic at FL350.

3.1.15. On questioning about the traffic at FL350 by ABY531, ACC Karachi (West) informed about traffic SEJ711 at FL350. No traffic information was passed to concerned aircraft earlier.

3.1.16. At the time of RA, 1,500 ft vertical separation existed between the two aircraft and standard separation was not infringed.

3.1.17. Both aircraft continued to their destination without any further incident.

3.2. Cause / Contributory Factors

3.2.1. Cause

3.2.1.1. Activation of TCAS – RA (**MAC – Mid Air Collision**) due to high Rate of Climb by ABY531 incurred during severe to moderate turbulence on route G214.

3.2.2. Contributory Factors

3.2.2.1. Nil

Note: Aviation Occurrence Category (ADREP Taxonomy)

“Mid-Air Collision (MAC): Separation-related occurrences caused by either air traffic control or cockpit crew

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SECTION 4 – SAFETY RECOMMENDATIONS

4.1. Safety Recommendations

4.1.1. PAA may advise ATC Controllers to issue traffic information to affected aircraft where TA/RA is likely to trigger.

4.1.2. PAA is to ensure that ATS Units adhere to the laid down procedures for the provisioning of Air Traffic Services (traffic information) in accordance with ICAO guidelines and best practices.

4.1.3. PAA and GCAA may ensure that aircrew may use appropriate procedures during climb or descend to an assigned altitude or flight level at a rate less than 1,500 ft / min throughout the last 1,000 ft of climb or descent to the assigned altitude or flight level as given in Doc 8168 Vol III and Flight Crew Technique Manual.