

FINAL INVESTIGATION REPORT



SERIOUS INCIDENT (TCAS – RA) REPORTED BY CHINA SOUTHERN AIRLINE FLIGHT CSN5237, BOEING 777-F1B AIRCRAFT, REG NO. B2072 (GUANGZHOU – RIYADH) ON 14TH MARCH, 2024

SCOPE

At Aircraft Accident Investigation Board (AAIB), 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 AAIB 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.

Extracts may be published without specific permission provided that the source is duly acknowledged, and the material is reproduced accurately, and is not used in a derogatory manner or in a misleading context.

TABLE OF CONTENTS

SECTION 1 - FACTUAL INFORMATION	9
1.1. History of the Flight	10
1.2. Injuries to Person(s)	10
1.3. Damage to Aircraft	10
1.4. Other Damage	10
1.5. Personnel Information	10
1.6. Aircraft Information	11
1.7. Meteorological Information	11
1.8. Aids to Navigation	11
1.9. Communications	11
1.10. Aerodrome Information	12
1.11. Flight Recorders	12
1.12. Wreckage and Impact Information	12
1.13. Medical and Pathological Information	12
1.14. Fire	12
1.15. Survival Aspects	12
1.16. Test and Research	13
1.17. Organizational and Management Information	13
1.18. Additional Information	13
1.19. Useful or Effective Investigation Techniques	14
SECTION 2 – ANALYSIS	15
2.1. General	16
SECTION 3 – FINDINGS	21
3.1. Findings	22
3.2. Cause / Contributory Factors	22
SECTION 4 – SAFETY RECOMMENDATIONS	23
4.1. Safety Recommendations	24

LIST OF FIGURES

Figure 1 CSN5237 Route	10
Figure 2 TCAS Traffic Alert (TA).....	13
Figure 3 TCAS TA & Resolution Advisory (RA) ranges	14
Figure 4 Traffic Display.....	14
Figure 5 CSN5237 at position TASOP	16
Figure 6 CSN5237 taken on Vectors to bypass Bholari Training Area	17
Figure 7 Military Traffic in Climbing Phase FL300 for Higher.....	17
Figure 8 CSN5237 received TCAS-RA.....	18
Figure 9 CSN5237 executed TCAS-RA Climb.....	18
Figure 10 Fighters Climb up to FL322	19
Figure 11 CSN5237 Climb up to FL330.....	19
Figure 12 CSN5237 descending back to FL320	20
Figure 13 Vertical and Lateral Separation	20

LIST OF TABLES

Table 1 Aircraft details – CSN5237	11
Table 2 METAR details.....	11
Table 3 Communication Frequencies for Karachi ACC	12

ABBREVIATIONS

AAIB	Aircraft Accident Investigation Board
ACC	Area Control Centre
ATC	Air Traffic Control
ATS	Air Traffic Services
CARs	Civil Aviation Rules
FIR	Flight Information Region
FL	Flight Level
ft	Feet
h	Hour(s)
ICAO	International Civil Aviation Organization
IOU	Incident Occurrence and Unserviceability Report
MAC	Mid Air Collision
METAR	Meteorological Aerodrome Report
min	Minute(s)
NM	Nautical Miles
OERK	King Khalid International Airport
PAF	Pakistan Air Force
PCAA	Pakistan Civil Aviation Authority
R/T	Radio/ Telephony
RA	Resolution Advisory
TA	Traffic Advisory
TCAS	Traffic Alert and Collision Avoidance System
UTC	Universal Time Coordinated
ZGGG	Guangzhou Baiyun International Airport

INTRODUCTION

This serious incident was reported to 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 authorizing AAIB, Pakistan to investigate the serious incident. This serious incident was notified³ to International Civil Aviation Authority (ICAO), Aviation Accident Investigation Division, China in line with Annex-13. The investigation has been conducted by AAIB, Pakistan. All corresponding timings are mentioned in Universal Coordinated Time (UTC).

¹ PCAA IOU Report dated 15th June, 2024

² Ministry of Aviation Memorandum No. AAIB/1902/008/TCAS/Inv/104 dated 30th May, 2024

³ Initial Notification to ICAO dated 16th April, 2024

SYNOPSIS

On 14th March, 2024, China Southern Airline flight CSN5237, Boeing 777-F1B aircraft, Reg. No. B-2072 was a cargo flight operating from Guangzhou Baiyun International Airport (ZGGG), Guangzhou, China to King Khalid International Airport (OERK) Riyadh, Saudi Arabia on Air Traffic Services (ATS) Route A325 TASOP-KE-KC-PARET-TAPDO. Meanwhile, Pakistan Air Force (PAF) fighter aircraft were operating in Bholari training area from FL100 to FL300.

When CSN5237 was crossing Bholari training area, one fighter aircraft climbed to FL322 and came in close proximity of CSN5237. As a result, CSN5237 climbed on Traffic alert and Collision Avoidance System – Resolution Advisory (TCAS-RA) up to FL329.

SECTION 1 - FACTUAL INFORMATION

1.1. History of the Flight

1.1.1. On 14th March, 2024, China Southern Airline flight CSN5237, Boeing 777-F1B aircraft, Reg. No. B-2072 was operating from ZGGG, Guangzhou, China to OERK, Riyadh, Saudi Arabia on ATS Route A325 TASOP-KE-KC- PARET-TAPDO.

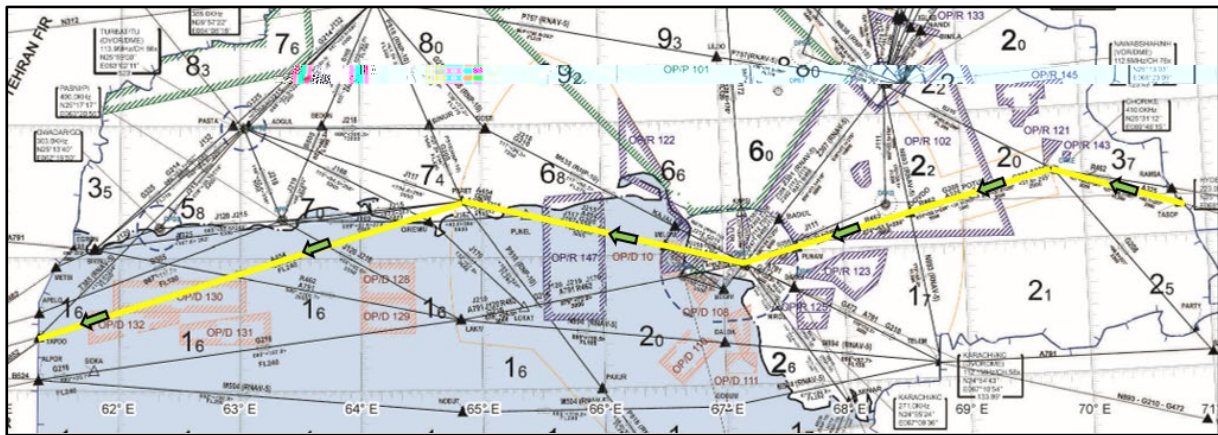


Figure 1 CSN5237 Route

1.1.2. PAF aircraft formation of 03 fighters were cleared in Bholari training area from PAF Base Bholari up to FL300.

1.1.3. Bholari flying areas were active up to FL400 in coordination with Area Control Centre (ACC) Karachi (East). Only Uniform South area was restricted by ACC Karachi (East) for Military traffic from FL100 to FL300, as civil traffic CSN5237 was transiting on route KE-KC-PARET crossing through the active areas of Bholari maintaining FL320.

1.1.4. Although CSN5237 was taken on radar vectors by ACC Karachi (East) Controller in order to bypass military areas, 01 fighter aircraft climbed to FL322 and came in close proximity of CSN5237.

1.1.5. As a result, CSN5237 climbed on TCAS-RA activation up to FL329.

1.1.6. At the time of occurrence, 400 ft vertical separation and 1.7 NM lateral separation existed between the two aircraft.

1.1.7. CSN5237 continued 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 the aircraft.

1.3. Damage to Aircraft

1.3.1. 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

CSN5237	
Aircraft Make & Model	Boeing 777-F1B
Registration Marking	B-2072
Manufacturer Serial No.	37310
Year of Manufacturer	2010
Operator	China Southern Airlines
Sector	Guangzhou to Riyadh
Engine Type	GE90-110B1L

Table 1 Aircraft details – CSN5237

1.7. Meteorological Information

1.7.1. No significant weather was reported by Pakistan Meteorological Department, Meteorological Aerodrome Report (METAR) for the time 1700 is as follows: -

1.7.2. 0400Z 33008KT 5000 FU NSC 24/19 Q1016 NOSIG RH71%

Time	0400 UTC
Wind Direction	330 degrees
Speed	08 Knots
Visibility	5,000 meters
Clouds	No Significant Cloud
Temperature	24°
Dewpoint	19°
Pressure	Q1016
Weather	No Significant Weather
Humidity	RH71%

Table 2 METAR details

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.

Name Lateral limits Vertical limits Class of airspace	Unit providing service	Callsign/ Language Area and conditions of use Hours of service	Frequency/ purpose	Remarks
1	2	3	4	5
KARACHI CTA Area bounded by lines joining points 233002N/0661001E; 241802N/0652502E; 242202N/ 0644902E then along the clockwise arc of a circle of 133NM radius centred on 245443N/0671054E to 263201N/0653202E; 261802N/0660601E; 251702N/ 0664401E; 251902N/0671901E; 262202N/0680200E; 265801N/0674001E; 270501N/0674001E then along the clockwise arc of a circle of 132.67NM radius centred on 245443N/0671054E to 263002N/ 0685000E; 260602N/0682900E then along the clockwise arc of a circle of 101.1NM radius centred on 245431N/0670946E to 253002N/0685000E; 254202N/0694100E; 252002N/0694800E; 251002N/ 0685900E then along the clockwise arc of a circle of 100.4NM radius centred on 245431N/0670946E to 241502N/0684800E then along Pakistan/India up to 233002N/0661001E to point of origin. UNL FL075 Class of airspace: A - At and above FL155 C - Below FL155	Karachi ACC (CENTRE)	Karachi Control (English) H24	121.5 MHZ Emergency FREQ 122.05 MHZ Primary FREQ 133.625 MHZ Secondary FREQ	RCAG
	Karachi ACC (EAST)	Karachi Control (English) H24	121.5 MHZ Emergency FREQ 126.5 MHZ 133.2 MHZ	
	Karachi ACC (WEST)	Karachi Control West (English) H24	121.5 MHZ Emergency FREQ 121.65 MHZ Secondary FREQ 128.35 MHZ Primary FREQ	
	Karachi ACC South	Karachi Control (South) (English) H24	121.95 MHZ Secondary FREQ 133.025 MHZ Primary FREQ	

Table 3 Communication Frequencies for Karachi ACC

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 2 TCAS Traffic Alert (TA)

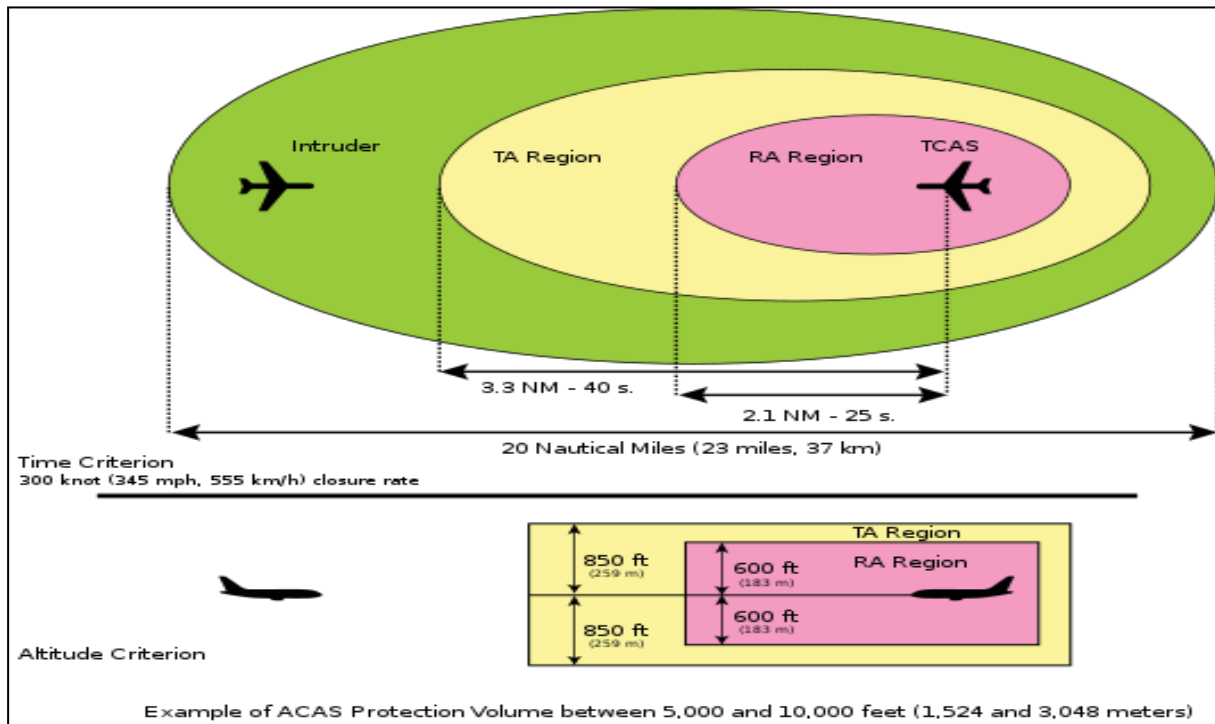


Figure 3 TCAS TA & Resolution Advisory (RA) ranges

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).

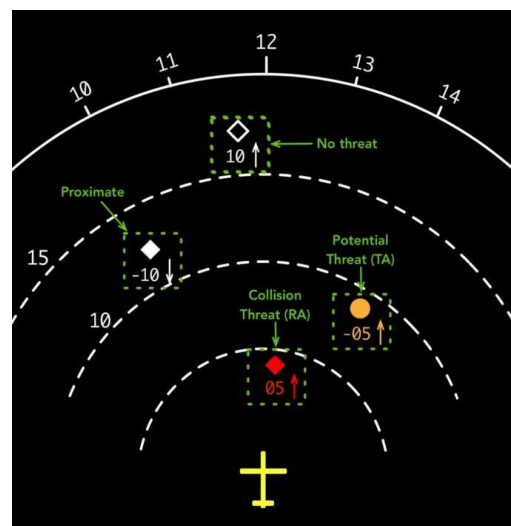


Figure 4 Traffic Display

1.19. Useful or 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. On 14th March, 2024, China Southern Airline flight CSN5237, Boeing 777-F1B aircraft, Reg. No. B-2072 was operating as a cargo flight from ZGGG, Guangzhou, China to OERK, Riyadh, Saudi Arabia on ATS Route A325 TASOP-KE-KC-PARET-TAPDO.

2.1.2. PAF aircraft formation of 03 fighters were cleared in Bholari training area from PAF Base Bholari up to FL300.

2.1.3. At 03:42:30 h, CSN5237 came in contact with ACC Karachi (East) maintaining FL320 and was cleared from TASOP to TAPDO via flight plan route.

2.1.4. At 03:47:56 h, Bholari Air Traffic Control (ATC) requested for FL400 and below in the military training areas from ACC Karachi (East), which was approved.

2.1.5. ACC Karachi (East) only restricted "Uniform South Area" for military traffic up to FL300 due to CSN5237 transiting at FL320.

2.1.6. At 03:50:55 h, CSN5237 checked position TASOP maintaining FL320 and was given direct routing to Karachi by East Surveillance Controller.

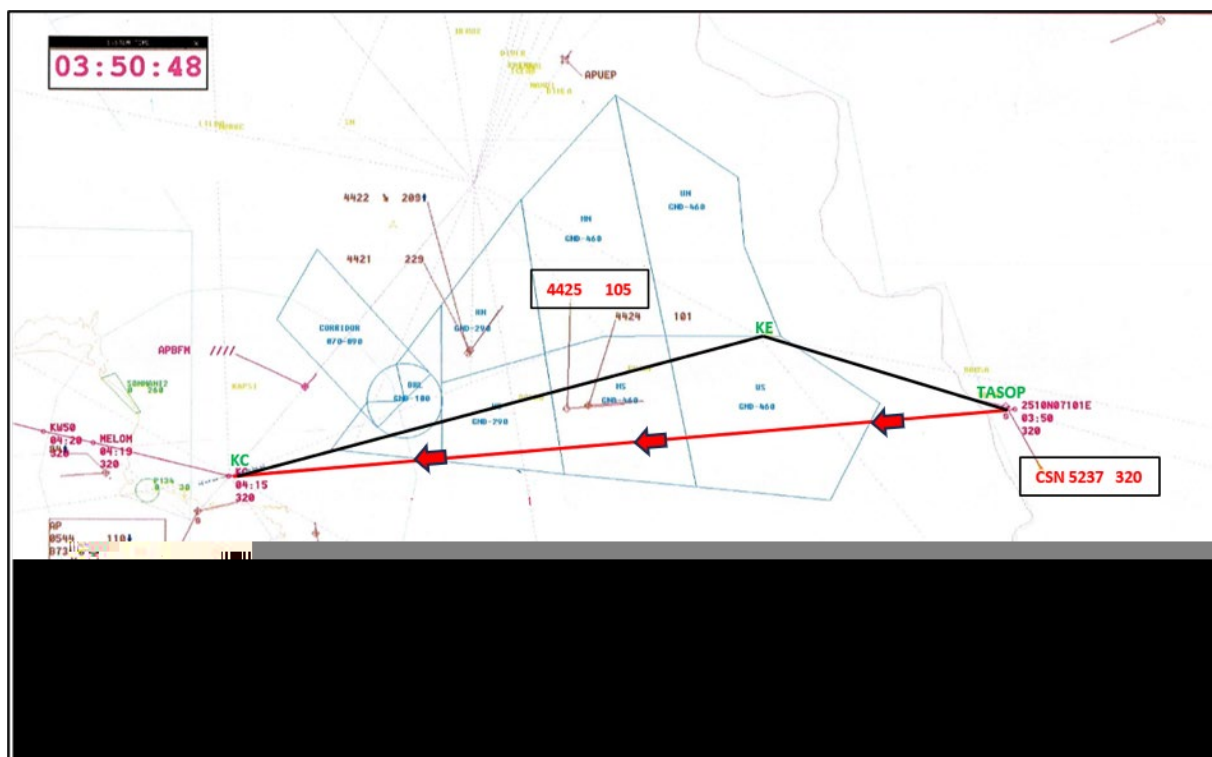


Figure 5 CSN5237 at position TASOP

2.1.7. At 03:52:48 h, when CSN5237 was 38 Nautical Miles (NM) South East of KE, it was taken on vectors towards South-West by East Surveillance Controller to bypass “Uniform South Area” and other Bholari training areas in which PAF fighters were operating at and below FL400.

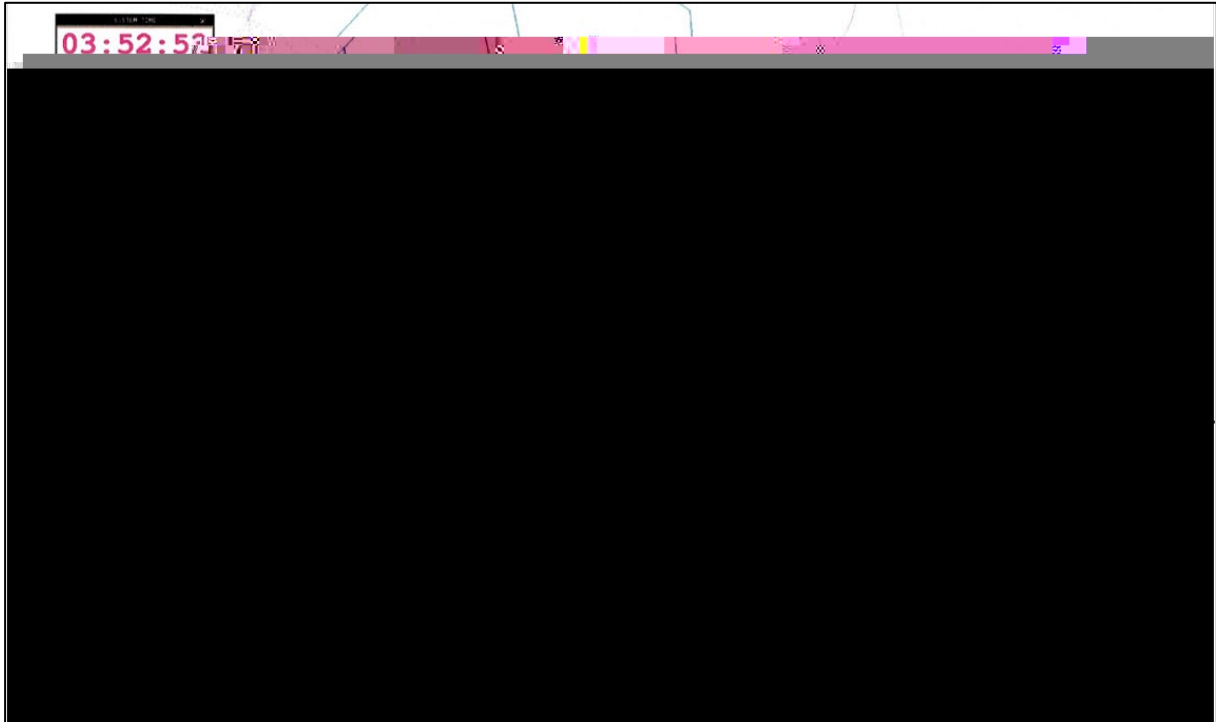


Figure 6 CSN5237 taken on Vectors to bypass Bholari Training Area

2.1.8. At 03:59:53 h, Surveillance East Controller tried to pass traffic information observed on Radar Display to CSN5237 regarding fighter aircraft Squawking A4425 16 NM reciprocal to CSN5237 in climbing phase passing FL300 for higher.

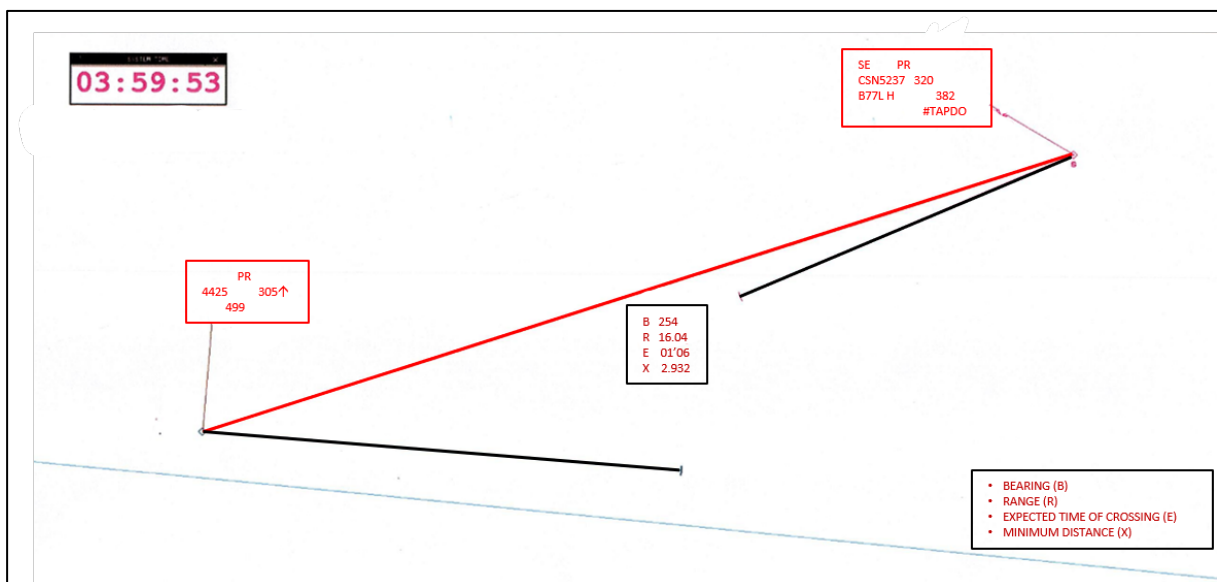


Figure 7 Military Traffic in Climbing Phase FL300 for Higher

2.1.9. At 04:00:31 h, CSN5237 expectedly received TCAS-RA due to fighter in climbing phase out of FL316.

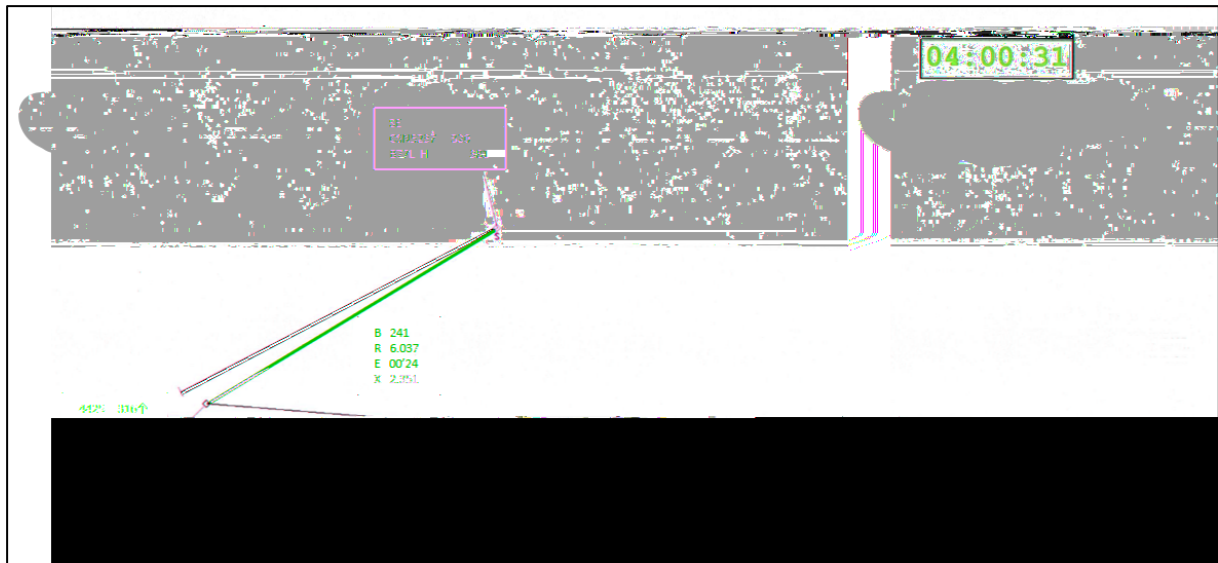


Figure 8 CSN5237 received TCAS-RA

2.1.10. At 04:00:47 h, as per Radar Screenshots CSN5237 executed TCAS-RA climb while fighter was still in climbing phase crossing FL319 at 2.6 NM.

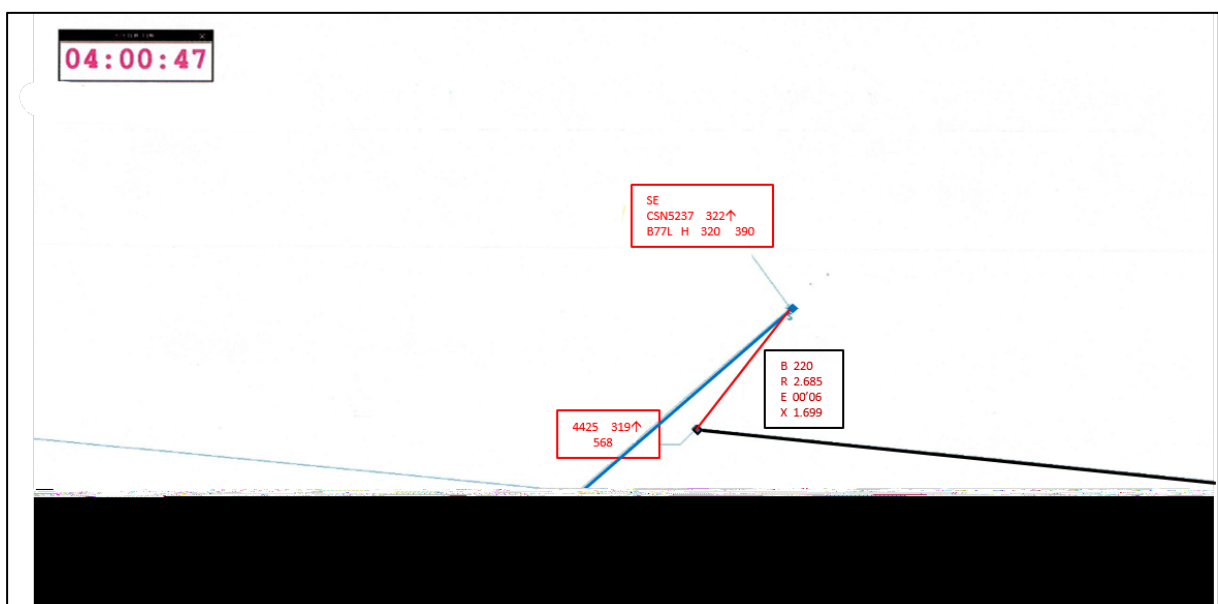


Figure 9 CSN5237 executed TCAS-RA Climb

2.1.11. At 04:01:02 h, military aircraft had climbed up to FL322 with separation of only 1.8 NM with CSN5237 which was climbing through FL326.

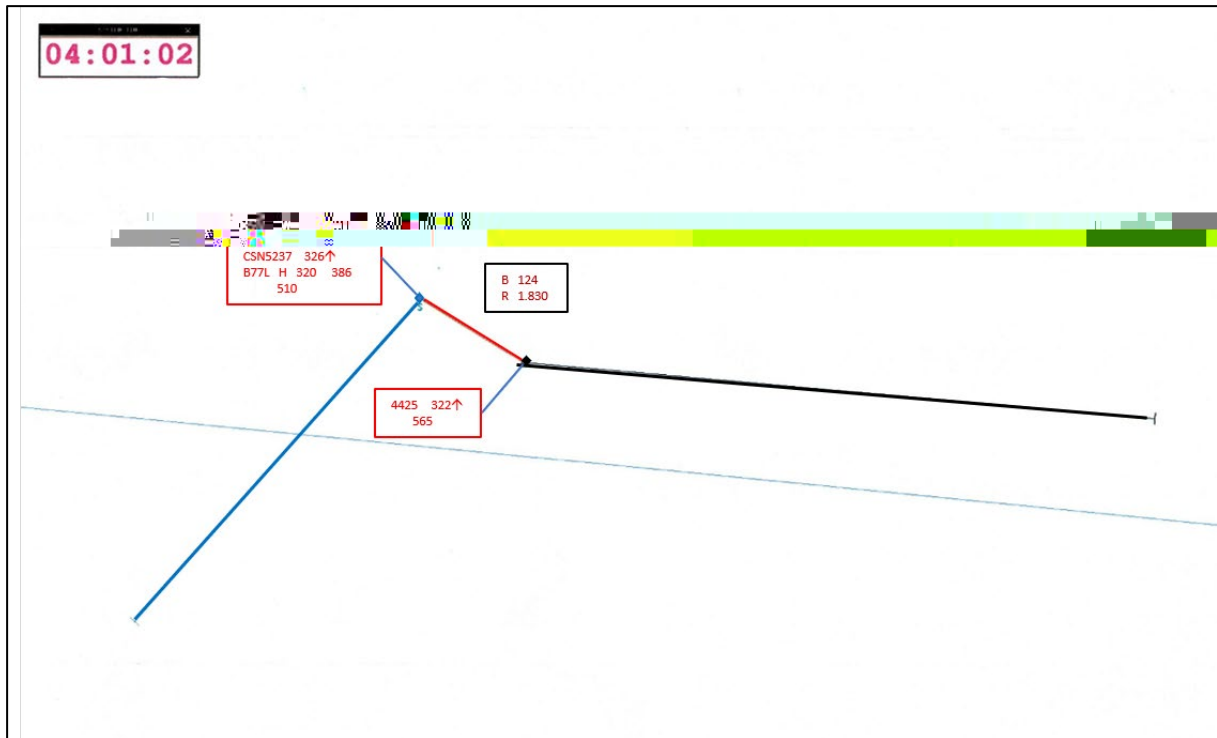


Figure 10 Fighters Climb up to FL322

2.1.12. At 04:01:10 h, CSN5237 reported having executed a TCAS – RA manoeuvre climb to FL330 and was descending back to FL320.

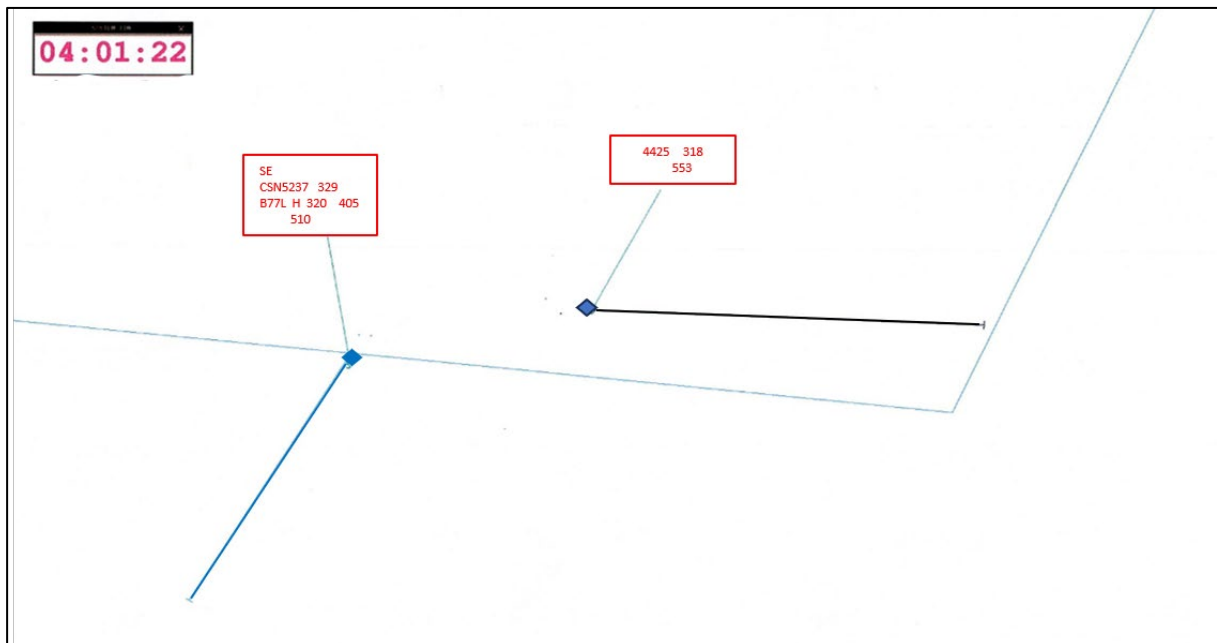


Figure 11 CSN5237 Climb up to FL330

2.1.13. At 04:01:39 h, CSN5237 again reported that it had climbed to FL330 due to TCAS-RA manoeuvre and was now back to FL320.

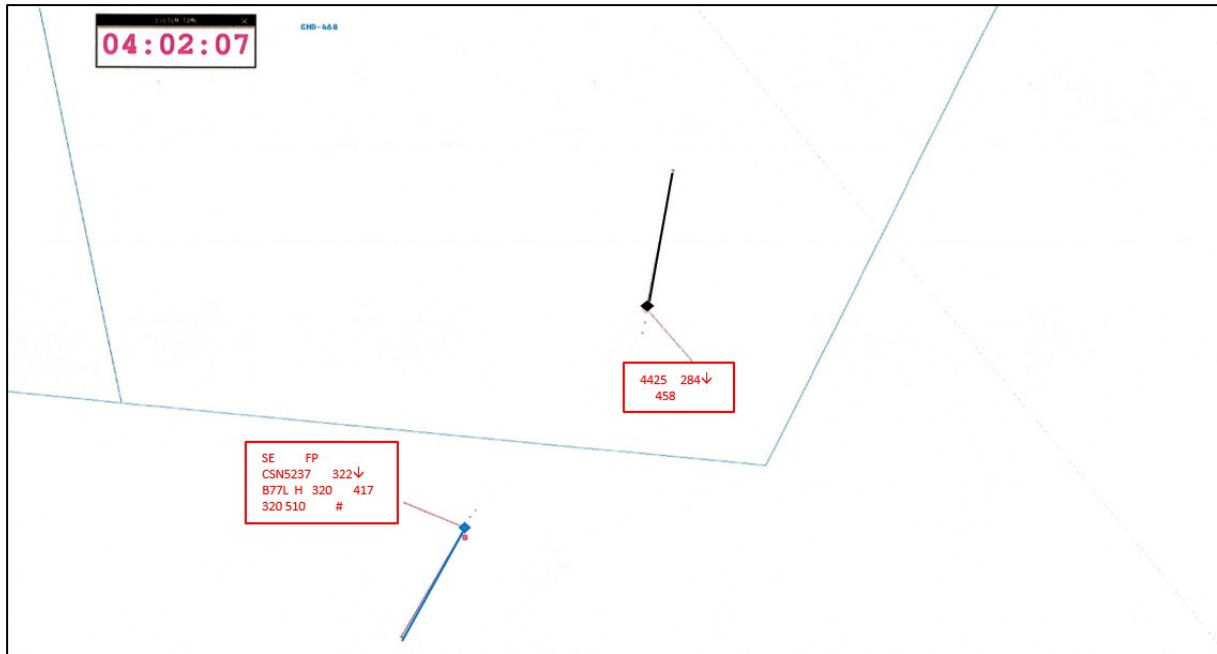


Figure 12 CSN5237 descending back to FL320

2.1.14. The closest separation between both aircraft was 400 ft vertical and 1.7 NM lateral.

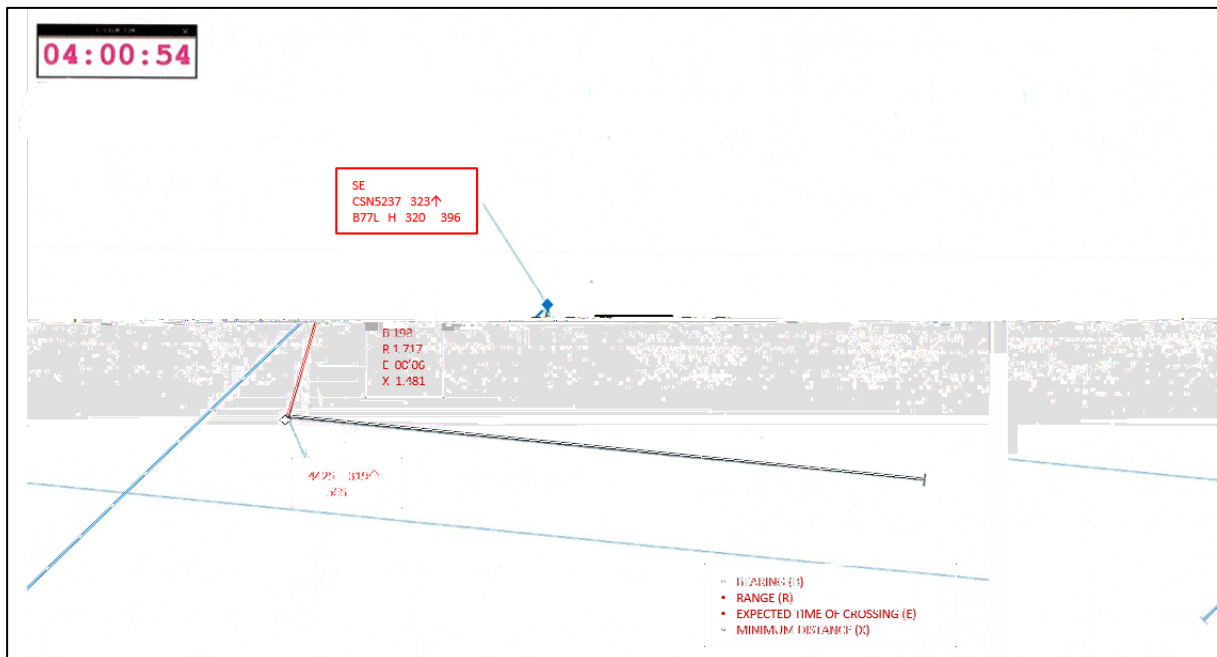


Figure 13 Vertical and Lateral Separation

2.1.15. CSN5237 continued its flight to the destination according to its flight plan without any further incident.

2.1.16. At 04:04:37 h, Bholari ATC Controller acknowledged that military traffic was instructed to remain at FL300 and below and it had violated the instructions.

2.1.17. Moreover, the direct speech circuit between ACC Karachi (East) and Bholari was unserviceable while incoming calls from Bholari were mostly undecipherable by ACC Karachi as per ATC Controller statement.

SECTION 3 – FINDINGS

3.1. Findings

- 3.1.1. China Southern Airline flight CSN5237, Boeing 777-F1B, Reg. No. B-2072 was operating a cargo flight from ZGGG, Guangzhou, China to OERK, Riyadh, Saudi Arabia on ATS Route A325 TASOP-KE-KC-PARET-TAPDO maintaining FL320.
- 3.1.2. Bholari training area was active from FL100 to FL400.
- 3.1.3. Bholari Uniform South Area was restricted up to FL300 by ACC Karachi (East) due to the transiting traffic CSN5237 at FL320
- 3.1.4. CSN5237 came in contact with ACC Karachi (East) approaching position TASOP maintaining FL320 and was cleared from TASOP to Karachi on direct track.
- 3.1.5. Later CSN5237 was given radar vectors by ACC Karachi (East) to bypass the active Bholari training areas.
- 3.1.6. Upon observing one fighter aircraft climbing beyond the restricted FL300 in Uniform South Area reaching up to FL322, ACC Karachi (East) attempted to inform CSN5237 about fighter traffic but the Radio Telephony (R/T) was unreadable by CSN5237.
- 3.1.7. At the same time, CSN5237 received TCAS-RA alert and executed climb.
- 3.1.8. Fighter aircraft reached FL322 with a separation of 1.7 NM laterally and 400 ft vertically from CSN5237.
- 3.1.9. CSN5237 climbed to FL329 as per TCAS-RA before descending back to FL320.
- 3.1.10. The direct speech circuit between ACC Karachi (East) and Bholari was unserviceable, leading to undecipherable / intermittent communications.
- 3.1.11. The PAF fighter aircraft violated the instruction to remain below FL300.
- 3.1.12. Problematic Direct Speech Circuit between ACC Karachi (East) and Bholari ATC contributed to the incident.
- 3.1.13. CSN5237 continued to its destination without further incident after executing the TCAS-RA manoeuvre.

3.2. Cause / Contributory Factors

3.2.1. Cause

- 3.2.1.1. Unauthorized climb by PAF fighter aircraft beyond the restricted FL300.

3.2.2. Contributory Factors

- 3.2.2.1. Due to unserviceability of direct speech circuit between Karachi ACC (East) and Bholari, proper coordination could not be done in timely manner.
- 3.2.2.2. Intermittent R/T communication between ACC Karachi (East) and CSN5237.

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 Headquarters may ensure briefing on working of TCAS-RA for fighter aircrew.
- 4.1.2. PCAA and Air Headquarters may ensure that the direct speech circuit between military air bases and civil airports are in serviceable condition to facilitate clear and continuous communication.
- 4.1.3. PCAA and Air Headquarters may re-evaluate and possibly redesign airspace structure around military training areas to minimize the overlap with civilian flight paths.