

FINAL INVESTIGATION REPORT



**INCIDENT OF TCAS-RA REPORTED BY TURKMENISTAN
AIRLINE FLIGHT TUA562, B752, REG NO EZA014 (AMRITSAR –
ASHGABAT) & INDIGO AIRLINES FLIGHT IGO048 A320 REG NO
VTIEP (DUBAI – AMRITSAR) ON 04-11-2018**

SCOPE

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ABBREVIATIONS

1.	ACC	Area Control Center
2.	AIRPROX	Aircraft Proximity
3.	AMSL	above mean sea level
4.	ANS	Air Navigation Service
5.	ANSP	Air Navigation Service Provider
6.	ATC	Air Traffic Control
7.	ATCO	Air Traffic Controller
8.	AVSA	Adjust vertical speed adjust
9.	COM	Communication
10.	CRM	Crew Resource Management
11.	hrs	hours
12.	ICAO	International Civil Aviation Organization
13.	IIC	Investigator In Charge
14.	ILS	Instrument Landing System
15.	KIAS	Knots Indicated Air Speed
16.	Km	kilometers
17.	LT	Local Time
18.	m	metres
19.	mb	millibars
20.	No.	Number
21.	OK	all correct
22.	OMDB	Dubai
23.	QNH	Barometric pressure adjusted to sea level
24.	RH	Right Hand
25.	RoD	Rate of Descent
26.	SN	Serial Number
27.	SOP	Standard Operating Procedures
28.	STCA	Short Term Conflict Alert
29.	TCAS	Traffic alert and Collision Avoidance System
30.	TCAS RA	Traffic alert Collision Avoidance System Resolution Advisory
31.	TO	Take Off
32.	UTC	Co-ordinated Universal Time
33.	UTAA	Ashgabat
34.	VIAR	Amritsar

**THE AAIB PAKISTAN ICAO ANNEX 13 AIRCRAFT ACCIDENT INVESTIGATION
BOARD TEAM**

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FINAL INVESTIGATION REPORT

INCIDENT OF TCAS – RA REPORTED BY TURKMENISTAN AIRLINE FLIGHT TUA562, B752, REGNO EZA014 (AMRITSAR – ASHGABAT) & INDIGO AIRLINES FLIGHT IGO048 A320 REGNO VTIEP (DUBAI TO AMRITSAR) ON 04-11-2018

Synopsis

On 04 November 2018, Turkmenistan Airlines Flight TUA562, aircraft B752, Reg No EZA014, operating from Amritsar to Ashgabat (VIAR – UTAA) was restricted at FL140 due reciprocal traffic. The reciprocal traffic Indigo Airlines Flight IGO048, aircraft A320, Reg No VTIEP was operating from Dubai to Amritsar (OMDB – VIAR) and was descending to FL150. TUA562 reported TCAS-RA and descended to FL135 due to reciprocal traffic. IGO048 was observed at FL148 and later on climbed to FL150 under TCAS-RA. Both aircraft received TCAS-Resolution Advisory.

This incident of TCAS-RA was reported in daily IOU report for the period 040500LT to 050500LT November 2018. AAIB Pakistan was authorized by the Government of Pakistan vide memorandum HQCAA/1904/40-130/SIB/480 dated 14 November 2018 to investigate this serious incident.

All available evidences have been analyzed by AAIB. No injuries were reported. At the time of minimum vertical separation of 800ft (between both aircraft), the lateral separation was 4.38 Nm (and reducing). Both aircraft crossed each other with a vertical separation of about 1000ft approximately. The incident occurred due to lapse on the part of Aircrew of IGO048 and possible contribution by lapse on the part of Lahore ATC. Appropriate recommendations have been made for both the operators body.

1. FACTUAL INFORMATION

1.1 History of Flights.

- 1.1.1 On 04 November 2018, Indigo Airlines (state of Operator and Registry – India) flight IGO048, aircraft A320, Reg No VTIEP, was operating from Dubai to Amritsar (OMDB – VIAR) on ATS route MOLTA – O/H Lahore – RABAN.
- 1.1.2 At 03:57:40 descent of inbound IGO048 (reciprocal traffic) was coordinated between ATC Lahore and ATC Amritsar, for FL110.
- 1.1.3 At 04:08:06 UTC, IGO018 contacted ATC Lahore (ACC Radar East) and was instructed to report ready for descend.
- 1.1.4 Turkmenistan Airline (state of Operator and Registry – Turkmenistan) flight TUA562 aircraft B752 Reg No EZA014 was operating from Amritsar to Ashgabat (VIAR – UTAA) on ATS route RABAN – O/H Lahore – JHANG.
- 1.1.5 At 04:16:13 initial coordination was made between Lahore ATC and Amritsar ATC prior to departure of TUA562. ATC Lahore asked Amritsar ATC to advise TUA562 to maintain FL100 by position RABAN.
- 1.1.6 At 04:20:45, IGO048 requested descent. ATC Lahore (ACC Radar East) cleared IGO048 to descend to FL250. ATC Lahore (ACC Radar East) also passed traffic information about QATARI B777 which was 10 o'clock range 17 NM and passing FL343 for FL360. Both calls (i.e clearance / traffic info) were acknowledged by IGO048.
- 1.1.7 At 04:23:48, ATC Lahore (ACC Radar East) re-cleared IGO048 to FL170 and acknowledged by IGO048.
- 1.1.8 At 04:28:11 ATC Amritsar passed airborne time of TUA562 and ATC Lahore cleared TUA562 to climb FL140 and to cross RABAN FL120 or above.
- 1.1.9 At 04:31:05, IGO048 requested further descend and ATC Lahore (ACC Radar East) asked to remain standby for further descend.
- 1.1.10 At 04:31:16, ATC Lahore (ACC Radar East) cleared descent to IGO048 to FL150, but it was not acknowledged by the aircraft.
- 1.1.11 At 04:31:50, TUA562 contacted ATC Lahore and reported approaching position "RABAN" FL120. ATC Lahore (ACC Radar East) asked TUA562 to climb and maintain Level 140 and standby for higher. Same was appropriately acknowledged by TUA562.
- 1.1.12 At the same time ATC Lahore (ACC Radar East) gave call to IGO048 to maintain FL150 with traffic information on reciprocal traffic (got airborne from Amritsar,

climbing to FL140, and approaching RABAN). IGO048 acknowledged by saying “**COPIED**”.

- 1.1.13 At 04:32:11 radar display data was showing TUA562 passing FL123 ↑ for FL140 and IGO048 passing FL161 ↓. The Mode “S” information of IGO048 was showing selection of FL150 and rate of descent -1952 ft per minute. The reciprocal distance between two aircrafts was 19.77 NM.
- 1.1.14 At 04:32:26 radar display data was showing IGO048 passing FL157 ↓. The Mode “S” information of IGO048 was showing selection of **FL140** and rate of descent -1632 ft per minute. The reciprocal distance between TUA562 and IGO048 was 16.90 NM.
- 1.1.15 At 04:32:31 radar display data was showing IGO048 passing FL156 ↓. The Mode “S” information of IGO048 was showing selection of **FL140**. The reciprocal distance between TUA562 and IGO048 was 16.05 NM.
- 1.1.16 At 04:32:35 radar display data was showing IGO048 passing FL154 ↓. The Mode “S” information of IGO048 showing selection of **FL140**. The reciprocal distance between TUA562 and IGO048 was 15.10 NM.
- 1.1.17 At 04:32:50 radar display data was showing TUA562 climbing to FL 140 and passing FL135 ↑ and IGO048 was passing FL151 ↓. The Mode “S” information of IGO048 showing selection of **FL140**. The reciprocal distance between two aircrafts was 12.23NM.
- 1.1.18 At 04:33:00 radar display data was showing IGO048 passing FL148 ↓. TUA562 was passing FL137 ↑. The reciprocal distance between TUA562 and IGO048 was 10.26NM.
- 1.1.19 At 04:33:23 IGO048 called ATC Lahore and in a blocked transmission reported RA (Resolution Advisory).
- 1.1.20 ATC Lahore (ACC Radar East) asked IGO048 to maintain FL150. Furthermore ATC Lahore reminded IGO048 that she was advised to maintain FL150 with traffic information. IGO048 replied “**Level 150 maintaining**”.
- 1.1.21 At 04:33:28 radar display data was showing IGO048 still at FL148 ↓. TUA562 was maintaining FL140. The reciprocal distance between TUA562 and IGO048 was 04.38NM.
- 1.1.22 At 04:33:36 TUA562 called ATC Lahore and reported maintain in FL140 and acknowledged by ATC Lahore.
- 1.1.23 At 04:34:09 TUA562 initiated call to ATC Lahore for which ATC Lahore asked her to maintain FL140. TUA562 reported that they descended to FL130 due traffic. ATC Lahore inform TUA562 that traffic was advised to maintain FL150 and it was on FL148.

1.1.24 At 04:34:11 the radar display data was showing TUA562 FL135 ↓ and IGO048 was at FL148↑ and they had crossed each other.

1.1.25 At 04:35:54 IGO048 reported position RABAN and requested to changeover to Amritsar. ATC Lahore (ACC Radar East) asked IGO048 the reason to descend below FL150. IGO048 replied that as per them, they were cleared FL140. ATC Lahore informed IGO048 that they were cleared FL150 with traffic information about flight at FL140. IGO048 accepted that may be they mistook the instructions.

1.2 **Injuries to person(s).** No injury was reported to any one on board in both the aircraft.

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.**

Turkmenistan Airlines	:	TUA562
Aircraft Make	:	Boeing
Type of Aircraft	:	B752
Aircraft Registration	:	EZA014
State of Operator / Registration	:	Turkmenistan
Sector	:	Amritsar–Ashgabat
Flight Conditions	:	IMC / Maintaining FL140
Altitude	:	FL140(for final FL340)

M/s Indigo Airline	:	IGO048
Aircraft Make	:	Airbus
Type of Aircraft	:	A320
Aircraft Registration	:	VTIEP
State of Operator / Registration	:	India
Sector	:	Dubai–Amritsar
Flight conditions	:	IMC / Descending Phase
Altitude	:	FL148 (FL250 to FL150)

1.6 **Meteorological Information.** No significant weather was reported at operating altitude at the time of occurrence.

1.7 **ATC Records.** AudioTape 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 TCAS (Traffic Alert and Collision Avoidance System)

1.9.1.1 A traffic collision avoidance system or traffic alert and collision avoidance system (both abbreviated as TCAS, and pronounced /ti: kæs/; TEE-kas) is an aircraft collision avoidance system designed to reduce the incidence of mid-air collisions between aircraft. It monitors the airspace around an aircraft for other aircraft equipped with a corresponding active transponder, independent of air traffic control, and warns pilots of the presence of other transponder-equipped aircraft which may present a threat of mid-air collision (MAC).

1.9.1.2 TCAS involves communication between all aircraft equipped with an appropriate transponder (provided the transponder is enabled and set up properly). Each TCAS-equipped aircraft interrogates all other aircraft in a determined range about their position (via the 1.03 GHz radio frequency), and all other aircraft reply to other interrogations (via 1.09 GHz). This interrogation-and-response cycle may occur several times per second.

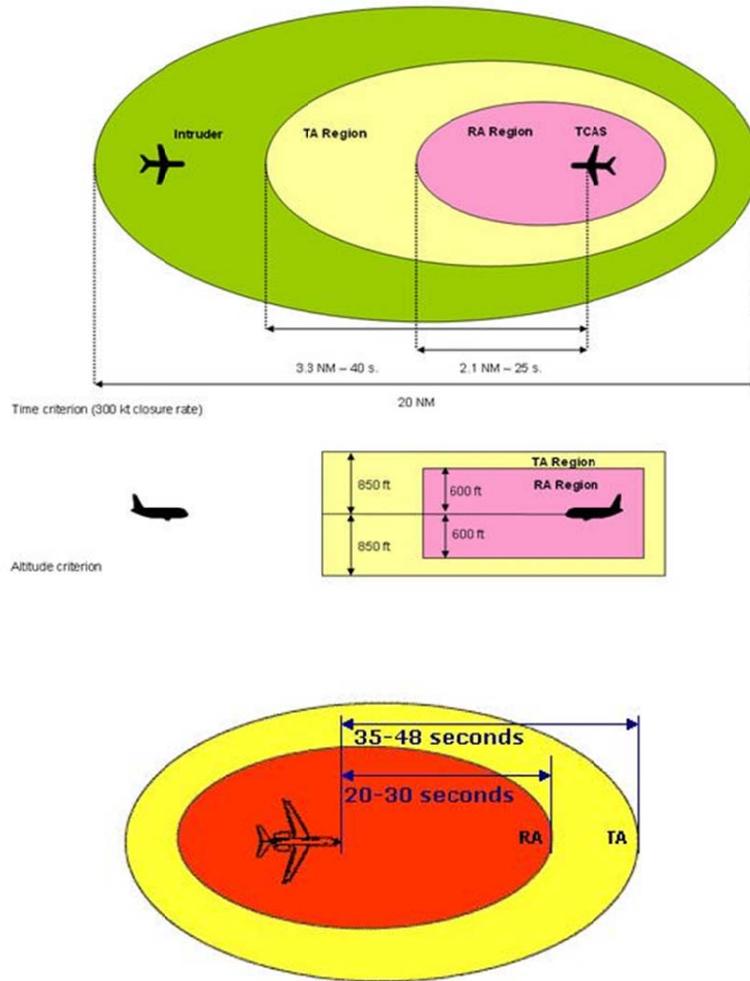
1.9.1.3 The TCAS system builds a three dimensional map of aircraft in the airspace, incorporating their range (garnered from the interrogation and response round trip time), altitude (as reported by the interrogated aircraft), and bearing (by the directional antenna from the response). Then, by extrapolating current range and altitude difference to anticipated future values, it determines if a potential collision threat exists.

1.9.1.4 TCAS II issues the following types of aural annunciations:

- Traffic advisory (TA)
- Resolution advisory (RA)
- Clear of conflict

1.9.1.5 When a TA is issued, pilots are instructed to initiate a visual search for the traffic causing the TA. If the traffic is visually acquired, pilots are instructed to maintain visual separation from the traffic. Training programs also indicate that no horizontal maneuvers are to be made based solely on information shown on the traffic display. Slight adjustments in vertical speed while climbing or descending, or slight adjustments in airspeed while still complying with the ATC clearance are acceptable.

1.9.1.6 When an RA is issued, pilots are expected to respond immediately to the RA unless doing so would jeopardize the safe operation of the flight. This means that aircraft will at times have to manoeuver contrary to ATC instructions or disregard ATC instructions. In these cases, the controller is no longer responsible for separation of the aircraft involved in the RA until the conflict is terminated.



1.9.2 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 Semicircular rule for cruising levels as specified in ICAO Annex 2 (Appendix-3):-

TRACK**											
From 000 degrees to 179 degrees***						From 180 degrees to 359 degrees***					
IFR Flights			VFR Flights			IFR Flights			VFR Flights		
Level			Level			Level			Level		
FL	Feet	Metres	FL	Feet	Metres	FL	Feet	Metres	FL	Feet	Metres
010	1 000	300	–	–	–	020	2 000	600	–	–	–
030	3 000	900	035	3 500	1 050	040	4 000	1 200	045	4 500	1 350
050	5 000	1 500	055	5 500	1 700	060	6 000	1 850	065	6 500	2 000
070	7 000	2 150	075	7 500	2 300	080	8 000	2 450	085	8 500	2 600
090	9 000	2 750	095	9 500	2 900	100	10 000	3 050	105	10 500	3 200
110	11 000	3 350	115	11 500	3 500	120	12 000	3 650	125	12 500	3 800
130	13 000	3 950	135	13 500	4 100	140	14 000	4 250	145	14 500	4 400
150	15 000	4 550	155	15 500	4 700	160	16 000	4 900	165	16 500	5 050
170	17 000	5 200	175	17 500	5 350	180	18 000	5 500	185	18 500	5 650
190	19 000	5 800	195	19 500	5 950	200	20 000	6 100	205	20 500	6 250
210	21 000	6 400	215	21 500	6 550	220	22 000	6 700	225	22 500	6 850
230	23 000	7 000	235	23 500	7 150	240	24 000	7 300	245	24 500	7 450
250	25 000	7 600	255	25 500	7 750	260	26 000	7 900	265	26 500	8 100
270	27 000	8 250	275	27 500	8 400	280	28 000	8 550	285	28 500	8 700
290	29 000	8 850				300	30 000	9 150			
310	31 000	9 450				320	32 000	9 750			
330	33 000	10 050				340	34 000	10 350			
350	35 000	10 650				360	36 000	10 950			
370	37 000	11 300				380	38 000	11 600			
390	39 000	11 900				400	40 000	12 200			
410	41 000	12 500				430	43 000	13 100			
450	45 000	13 700				470	47 000	14 350			
490	49 000	14 950				510	51 000	15 550			
etc.	etc.	etc.				etc.	etc.	etc.			

1.9.4 ICAO Doc4444 (PANS-ATM) specifies criterion to be used to determine that a specific level is occupied by an aircraft at para 8.5.5.2.1 states that:-

“The criterion which shall be used to determine that a specific level is occupied by an aircraft shall be ±60 m (±200 ft) in RVSM airspace. In other airspace, it shall be ±90 m (±300 ft), except that the appropriate ATS authority may specify a smaller criterion, but not less than ±60 m (±200 ft), if this is found to be more practical”.

1.9.5 Moreover, the Separation Minima Based on ATS Surveillance System as given in ICAO Doc4444 (PANS-ATM) at para 8.7.3.3 states that:-

“The separation minimum or minima based on radar and/or ADS-B and/or MLAT systems to be applied shall be prescribed by the appropriate ATS authority according to the capability of the particular ATS surveillance system or sensor to accurately identify the aircraft position in relation to the center of a position symbol, PSR blip, SSR response and taking into account factors which may affect the accuracy of the ATS surveillance system-derived information, such as aircraft range from the radar site and the range scale of the situation display in use”.

1.9.6 ICAO Doc 8168 Vol III Chapter 3 Para 3.3 states that:-

“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 1500 ft/min) throughout the last 300 m (or 1000 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. Detailed information on HVR encounters and guidance material concerning the development of appropriate procedures is contained in Attachment B to this chapter”.

2. ANALYSIS

- 2.1 The flight IGO048 was operating from Dubai to Amritsar. She requested descent and ATC Lahore (ACC Radar East) cleared her to descend to FL250. Later-on, she was re-cleared for FL170. Both calls and levels were acknowledged / appropriately read back. Further Lahore ATC re-cleared her to descent FL150 but this time the call was not acknowledged.
- 2.2 The other flight TUA562 operating from Amritsar to Ashgabat contacted ATC Lahore (ACC Radar East) while approaching position RABAN at FL120. ATC Lahore (ACC Radar East) cleared her to climb and maintain FL140 which was appropriately acknowledged.
- 2.3 ATC Lahore once again instructed IGO048 to maintain Level 150 and passed traffic information about TUA562 (reciprocal traffic which was climbing FL140). IGO048 acknowledged the call by using word “copied”.
- 2.4 The Mode “S” information of IGO048 kept showing selection of FL150 as descend level until time 04:32:25.
- 2.5 At 04:32:26 radar display was showing IGO048 passing FL157↓. Whereas, during investigation a change in the selection of descend level from FL150 to **FL140** is **discovered** in Mode “S” information window. This change in the selection of descent level from FL150 to FL140 in the cockpit (as shown in Mode “S” information) indicates misunderstanding or confusion among the cockpit crew. Although cockpit crew acknowledged traffic information about the reciprocal TUA562 which was climbing FL140.
- 2.6 This selection of FL 140 is also against the ***Semi-Circular Rule of Cruising Altitudes***.
- 2.7 At this time the RoD of IGO048 was -1632 fpm contrary to the recommended RoD of 1500 fpm or less.
- 2.8 At 04:33:23 IGO048 informed ATC Lahore that they got TCAS-RA. ATC Lahore instructed IGO048 to maintain FL150 and reminded her of reciprocal traffic. IGO048 reported maintaining FL150. But at that moment radar display was showing IGO048 at FL148↓ (with the selection of FL140 as descend level) and TUA562 maintaining FL140. IGO048 did not descend any further below FL148 and TUA562 maintained FL140.
- 2.9 The change in the level of IGO048 was very less (i.e 200 ft). Lesser than the criteria used to determine that a specific level is occupied by an aircraft or not. Therefore it did not cause / create an alarm for the duty controller.

- 2.10 Minimum vertical separation was 800 ft, and lateral separation at this time was 4.38 Nm (and reducing).
- 2.11 At 04:33:36 TUA562 reported that it was maintaining FL140 and Lahore ATC acknowledged the same.
- 2.12 Later on at 04:34:09 radar display was showing that TUA562 had descended to FL135↓. ATC Lahore asked TUA562 to maintain FL140. TUA562 replied that they initiated descend to FL130 due to traffic. ATC Lahore reaffirmed that the traffic was advised (cleared) to maintain FL150 and it was at FL148.
- 2.13 Shortly before 04:34:09 both aircraft crossed each other with a vertical separation between 800ft to 1200ft approximately.
- 2.14 At 04:35:54 Lahore ATC (ACC Radar East) asked IGO048 to report reason why she descended below FL150. She replied that they thought they were cleared to FL140. ATC Lahore replied in negative and informed IGO048 was cleared for FL150 and the traffic information was accordingly passed to them. IGO048 responded, "**MAY BE WE MISTOOK THE INSTRUCTIONS**".

3. CONCLUSIONS

3.1 Findings

- 3.1.1 Lahore ATC (ACC Radar East) cleared both the flights to operate at vertically separated levels maintaining applicable standard vertical separation of 1000' feet.
- 3.1.2 Radar Controller Lahore ATC (ACC Radar East) was continuously monitoring traffic operating under his areas of jurisdiction and alerted TUA562 as soon as observed level change.
- 3.1.3 IGO048 did not follow standard RT phraseology and did not acknowledge one call and at another instance did not read back the instructions in a prescribed manner.
- 3.1.4 IGO048 selected wrong altitude of F140 contrary to Semi-Circular Rule of Cruising Altitudes.
- 3.1.5 RoD of IGO048 was -1632 fpm contrary to the recommended RoD of 1500 fpm or less.
- 3.1.6 However, the change in the level of IGO048 was well within the specified criteria (i.e. ± 60 m / ± 200 ft) used to determine that a specific level is occupied by an aircraft, therefore it did not cause /create an alarm for the duty controller.
- 3.1.7 IGO048 misunderstood and selected a wrong level in the cockpit, however, it did not descend below FL148 i.e well within the specified criteria (i.e. ± 60 m / ± 200 ft) used to determine that a specific level is occupied by an aircraft ieFL150 in her case.

3.2 Cause(s) / Contributory factors of Occurrence

- 3.2.1 This incident occurred due to the misunderstanding / confusion on the part of the aircrew of IGO048. Even after receiving traffic information about TUA562 (reciprocal traffic) and supposedly knowing that FL140 was not a flight level (as ***Semi-Circular Rule of Cruising Altitudes***) for his flight path, he did not verify from ATC, furthermore he did not read back but simply acknowledged, and mistakenly selected wrong level.
- 3.2.2 Additionally, IGO048, despite having traffic information about TUA562 (reciprocal traffic), maintained higher rate of descent (1632ft per minute) contrary to the ICAO recommended rate of descent during the last 1000' feet of the assigned level i.e between FL160 to FL150 (Ref : ICAO Doc 8168 Vol III Chapter 3 Para 3.3)
- 3.2.3 **Contributory Factor:** Lahore ATC (ACC Radar East) could not identify inadvertent / wrong selection (from FL150 to FL140) made in the cockpit by IGO048, and simultaneously shown at radar display as Mode "S" information. Moreover Lahore ATC did not emphasize IGO048 once it did not acknowledge and did not read back the clearance / instructions.

4. Safety Recommendations

- 4.1 M/s Indigo Airline is to issue directions for flight crew, to follow the standard phraseology about acknowledgment and read back of ATC clearances / instructions as per ICAO Annex 11 Chapter 3 Para 3.7.3.
- 4.2 M/s Indigo Airline is to issue directions for compliance with the ICAO recommended "rate of climb / rate of descent during the last 1000ft of the assigned level" (Ref: ICAO Doc 8168 Vol III Chapter 3 Para 3.3) and may incorporate "Operational Use and Pilot Training Guidelines" Chapter 5 of ICAO Doc 9863 "Airborne Collision Avoidance System (ACAS) Manual" for pilot training / briefing.
- 4.3 Pakistan CAA (Operations Directorate) is to issue directions to under command ATC Units for proactive utilization of Mode"S" information of both aircraft during potentially conflicting traffic.
- 4.4 Pakistan CAA (Operations Directorate) is to issue directions emphasizing the importance of acknowledgment / read back of ATC clearances / instructions by aircraft as per the guidelines provided in ICAO Annex 11 Chapter 3 Para 3.7.3.