FINAL INVESTIGATION REPORT

INCIDENT OF TRAFFIC COLLISION AVOIDANCE SYSTEM – RESOLUTION ADVISORY (TCAS – RA) REPORTED BY M/S SAUDI ARABIAN AIRLINE FLIGHT SVA 9431 A332 REG NO TC-OCN JEDDAH – MULTAN (JED – MUX) ON 29-11-2018

SCOPE

Safety Investigation Board (SIB), 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. It is not the purpose of such an investigation to apportion blame or liability. Accordingly, it is inappropriate that SIB 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

THE SIB PAKISTAN ICAO ANNEX 13 SAFETY INVESTIGATION BOARD TEAM

Sr No	Name	Designation
1.	Air Commodore M Usman Ghani	President SIB Investigation In-charge
2.	Mr. Zubair Ghazi	Additional Director ATS Investigator SIB

FINAL REPORT

INCIDENT OF TCAS – RA REPORTED BY SAUDI AIRLINE FLIGHT SVA9431 A332 REG NO TC-OCN (JEDDAH– MULTAN) ON 29-11-2018

Synopsis

On 29th November 2018, Saudi Arabian Airline Flight No SVA9431, A332, Reg No TC-OCN, FL370, operating on Route R471 from Jeddah to Multan (OEJN–OPMT), was cleared to decent FL350 due to crossing traffic, Oman Airline Flight No OMA261, B738, Reg No A40BM, FL370, Muscat to Lucknow (OOMS–VILK) on route G214, converging at Rahim Yar Khan (OPRK). Due to the reciprocal traffic, Pakistan International Airline Flight No PIA303, B777, FL360, operating on Route J112 from Lahore to Karachi (OPLA–OPKC), the aircraft SVA9431 was instructed to expedite reaching FL350. SVA9431 received Traffic Collision Avoidance System – Resolution Advisory (TCAS–RA) due to the reciprocal traffic Air Blue Flight ABQ201, A320, Reg No VNA650, FL340, operating on Route J112 from Islamabad to Karachi (OPIS–OPKC).

This incident of Traffic Collision Avoidance System –Resolution Advisory (TCAS-RA) was reported in daily IOU report for the period 290500LT to 300500LT November, 2018 Letter No HQCAA/1904/40/SIB dated 04th December 2018 and HQCAA/1904/40-133/SIB dated 14th December 2018 were issued by the SIB, Rawalpindi. Aviation Division Government of Pakistan issued memorandum. All available evidences have been analyzed by the Safety Investigation Board (SIB). Findings and Safety Recommendations of SIB are as under:-

1. FACTUAL INFORMATION

1.1 **History of Flights**. On 29th November 2018, Saudi Arabian Airline Flight No SVA9431, A332, Reg No TCOCN, FL370, operating on Route R471 from Jeddah to Multan (OEJN–OPMT), was cleared by ATC Karachi (ACC Radar North) to decent FL350 due to crossing traffic, Oman Airline Flight No OMA261, B738, A40BM, FL370, Muscat to Lucknow (OOMS–VILK) on route G214 was in contact with ATC Karachi (ACC Radar North), converging at Rahim Yar Khan (OPRK). Due to the reciprocal traffic, Pakistan International Airline Flight No PIA303, B777, FL360, operating on Route J112 from Lahore to Karachi (OPLA–OPKC), the aircraft SVA9431 was instructed by ATC Karachi (ACC Radar North) to expedite reaching FL350. SVA9431 received TCAS – RA due to the reciprocal traffic Air Blue Flight ABQ201, A320, Reg No VNA650, FL340, operating on Route J112 from Islamabad to Karachi (OPIS–OPKC). SVA9431 climbed to FL357 under TCAS–RA and while returning to FL350 infringed minimum standard horizontal separation of 15NM. Traffic information(s) were passed to SVA9431.

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**:

1.4.1	ATC Radar Controller (North)	:	**Mr. Habibullah**
	Designation	:	Dy. Director ATS
	ATCL #	:	0354
1.4.2	ATC Planner (North)	:	**Muhammad Ali**
	Designation	:	Sr. Dy. Director ATS
	ATCL #	:	0326
1.4.3	Team Leader ATC	:	**Mr. Nadeem Akhtar**
	Designation	:	Joint Director ATS
	ATCL #	:	0280

1.5 **Aircraft Information**.

1.5.1	Saudi Airlines	:	**SVA9431**
	Aircraft Make	:	Airbus
	Type of Aircraft	:	A332
	Aircraft Registration	:	TCOCN
	Sector	:	JEDDAH–MULTAN
	Flight conditions	:	IMC / Descending Phase
	Altitude	:	FL354 (FL370 ↓ FL350)
1.5.2	Airbule	:	**ABQ201**
	Aircraft Make	:	Airbus
	Type of Aircraft	:	A320
	Aircraft Registration	:	VNA650
	Sector	:	ISLAMABAD–KARACHI
	Flight conditions	:	IMC / Cruising
	Altitude	:	FL340
15.3	PIAC	:	**PIA303**
	Aircraft Make	:	Boeing
	Type of Aircraft	:	B777
	Aircraft Registration	:	APBMH
	Sector	:	LAHORE–KARACHI
	Flight conditions	:	IMC / Cruising
	Altitude	:	FL360

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

1.7 **ATC Record Tape Extracts:** Audio Tape Extracts and Video Record (Radar Tracings / SDD Screenshots) were obtained for detailed analysis

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

2. ANALYSIS

2.1 At 06:39:18, ABQ201 contacted ATC Karachi (ACC North) at position MOLTA, maintaining FL340 and was instructed to maintain FL340 and report position ZOHAR.

2.2 At 06:43:23, PIA303 contacted ATC Karachi (ACC North) at position MOLTA, maintaining FL360 and was instructed to maintain FL360 and report position ZOHAR.

2.3 At 07:05:12, SVA9431 contacted ATC Karachi (ACC North) maintaining FL370 on Route R471 approaching position ZOHAR.

2.4 At 07:10:04, OMS261, B738, maintaining FL370 on Route G214 was approaching overhead Sukkur (OPSK) and was expected to cross RK at almost the same time as that of SVA9431.

2.5 At 07:11:04, Karachi ATC (ACC Radar North) instructed SVA9431 to leave FL370 for FL350.

2.6 At 07:11:26, Karachi ATC (ACC Radar North) passed traffic information to SVA9431 about the reciprocal traffic, ABQ201 maintaining FL340 12 O'CLOCK RANGE 20NM.

2.7 At 07:11:54, Karachi ATC (ACC Radar North) instructed SVA9431 to expedite reaching FL350 which was passing through FL366 for FL350 and having a distance of 15NM (from ABQ201) with Mode 'S' information window showing inertial vertical rate (–960ft).

2.8 At 07:12:08, Karachi ATC (ACC Radar North) once again instructed SVA9431 to expedite reaching FL350 which was passing through FL365 for FL350 and having a distance of 10NM (from ABQ201) with Mode 'S' information window showing inertial vertical rate (–704 ft).

2.9 At 07:12:14, Karachi ATC (ACC Radar North) passed traffic information to ABQ201 about the reciprocal traffic, SVA9431 A332 descending FL350 12 O'CLOCK RANGE 08NM.

2.10 At 07:12:21, SVA9431 observed 46NM (from PIA303) passing through FL363 for FL350 and was having a distance of 08.76NM (from ABQ201) with Mode 'S' information window showing inertial vertical rate (–1312 ft) indicating increase in rate of descent.

2.11 At 07:12:25, SVA9431 observed 44NM (from PIA303) passing through FL361 for FL350 and was having a distance of 07.45NM (from ABQ201) with Mode 'S' information window showing inertial vertical rate (–1568 ft) indicating increase in rate of descent.

2.12 At 07:12:30, SVA9431 observed 43NM (from PIA303) passing through FL360 for FL350 and was having a distance of 06.15NM (from ABQ201) with Mode 'S'

information window showing inertial vertical rate (–2336 ft) indicating further increase in rate of descent.

2.13 At 07:12:35, SVA9431 passing through FL357 for FL350 was at a distance of 41.7NM from PIA303 at FL360 and at distance of 04.9NM from ABQ201 at FL340. Mode 'S' information window showing **inertial vertical rate (–3008 ft)**.

2.14 At 07:12:45, SVA9431 observed 39NM (from PIA303) passing through FL354 for FL350 and was having a distance of 02.38NM (from ABQ201) with Mode 'S' information window showing inertial vertical rate (–1504 ft) indicating reduction in previously maintained rate of descent.

2.15 At 07:12:55, SVA9431 observed crossing reciprocal traffic, ABQ201 (maintaining FL340) and climbing through FL356.

2.16 At 07:13:07, SVA9431 reported TCAS-Climb FL357 and returning to FL350. However, Radar Tracing at time 07:13:16 showing FL358↑.

2.17 At 07:13:29, SVA9431 informed Karachi ATC (ACC Radar North) that she climbed to FL357 under TCAS Climb and now returning to FL350.

2.18 At 07:13:34, SVA9431 observed 25.9NM (from PIA303) passing through FL357↓ for FL350 once again in descending phase.

2.19 At 07:13:48, PIA303 maintaining FL360 was instructed to turn left heading 180 degree.

2.20 At 07:14:05, SVA9431 reported maintaining FL350. However, at 07:14:16, radar tracing showing SVA9431 passing FL353 for FL350 and PIA303 FL360 observed turning left having a distance of 15.5NM (from SVA9431).

2.21 At 07:14:26, SVA9431 observed passing FL351 for FL350 at a distance of 12.85NM with PIA303. Karachi ATC (ACC North Radar) instructed PIA303 to proceed direct to ZOHAR.

2.22 At 07:14:40, SVA9431 observed maintaining FL350 at a distance of 08.8NM with PIA303.

2.23 At 07:32:52, SVA9431 was handed over to Multan APP/TWR for landing.

2.24 Duty Radar Controller (ACC North) stated in his statement and described in ATS Log Book that SV9431 after landing reported TCAS-RA climb was due to the traffic at FL350 whereas there wasn't any traffic at FL350 in the vicinity of SVA9431.

3. CONCLUSION

3.1 Findings

3.1.1 ABQ201, A320 Reg No. VNA650 a scheduled flight from Islamabad to Karachi maintaining FL340 came in contact with ATC Karachi (ACC North) at time

06:39:18UTC. PK303, B777 Reg No. APBMH, a scheduled flight from Lahore to Karachi maintaining FL360 came in contact with ATC Karachi (ACC North) at time 06:43:23UTC.SVA9431, A332, Reg No. TCOCN maintaining FL370 came in contact with ATC Karachi (ACC North) at time 07:05:12UTC.

3.1.2 OMA261 (B738 from Muscat to Lucknow) maintaining FL370 transit flight estimating RK at the same time as that of SVA9431.

3.1.3 At 07:11:04, Karachi ATC (ACC Radar North) instructed SVA9431 to leave FL370 for FL350 due to the conflicting traffic OMA261 at RK. However traffic information about the conflicting traffic (OMA261) was not provided to SVA9431. At that point in time there were other TWO (02)reciprocal aircraft which were given due consideration:

i) ABQ201 maintaining FL340 12 O'CLOCK Approximately 30NM restricting descent of SVA9431 below FL340.

ii) PIA303 maintaining FL360 12 O'CLOCK Approximately 68NM, well apart at this point in time.

3.1.4 At 07:11:26, Karachi ATC (ACC Radar North) passed traffic information to SVA9431about the reciprocal traffic, ABQ201 maintaining FL340 12 O'CLOCK RANGE 20NM.

3.1.5 At 07:11:54 (just after 50 seconds), Karachi ATC (ACC Radar North) instructed SVA9431 to expedite reaching FL350 which was passing through FL366 for FL350 due to reciprocal traffic, PIA303 maintaining FL360. At this point in time SVA9431 was at a distance of **15NM** with ABQ201 and its Mode 'S' information window was showing **inertial vertical rate (–960 ft)**, well within the recommended rate of descent**.**

3.1.6 At 07:12:08, Karachi ATC (ACC Radar North) once again instructed SVA9431 to expedite reaching FL350 which was passing through **FL365 for FL350** and was at a distance of **10NM** from ABQ201 maintaining FL340 and the with Mode 'S' information window showing **inertial vertical rate (–704 ft).**Reciprocal traffic, PIA303 maintaining FL360 was still well apart.

3.1.7 At 07:12:21, SVA9431 passing through FL363 for FL350 and started increasing rate of descent. The Mode 'S' information window was showing **inertial vertical rate (–1312 ft)**. At this point in time SVA9431 was at a distance of 46NM with reciprocal traffic PIA303 maintaining FL360 and at a distance of only 08.76NM from ABQ201 maintaining FL340.

3.1.8 At 07:12:35, SVA9431 passing through FL357 for FL350 was at a distance of 41.7NM from PIA303 and at distance of 04.9NM from ABQ201. Mode 'S' information window showing **inertial vertical rate (–3008ft)**.

3.1.9 During 28 seconds (i.e. from 07:12:08 to 07:12:35), SVA9431 shown an increase in her rate of descent from 704ft per minute to 3008ft per minute.

3.1.10 At 07:12:45, SVA9431 passing through FL354 for FL350 and was at a distance of 02.38NM from ABQ201. Mode 'S' information window was showing **inertial vertical rate (–1504 ft)** indicating **reduction** in the rate of descent.At this point in time SVA9431 received TCAS – RA "Climb" and initiated climb and went up to **FL358.** PIA303 was 39NM from SVA9431 at FL360 still well apart.

3.1.11 At 07:13:34, SVA9431 was once again in descending phase passing through **FL357↓ for FL350**and was at a distance of **25.9NM from PIA303** (reciprocal traffic at FL360). At this point in time, Karachi ATC (ACC Radar North) decided to take PIA303 on Radar Vector. At 07:13:48, PIA303 was instructed to **turn left heading 180 degree** due to the relative position of SVA9431. Traffic information was not provided to PIA303 before taking on Radar Vector and before instructing to resume normal (own) navigation.

3.1.12 At 07:14:05, SVA9431 reported maintaining FL350. However, radar tracing showing SVA9431 passing FL353 for FL350 and the relative distance was 15.5NM with PIA303 which was on Radar Heading 180 degrees.

3.1.13 At 07:14:26, SVA9431 was passing FL351 for FL350 and the relative distance with PIA303 was 12.85NM. Karachi ATC (ACC North Radar) instructed PIA303 to proceed direct to ZOHAR.

3.1.14 SVA9431 received / reported TCAS–RA activated and climbed upto FL358 under Resolution Advisory (TCAS–RA).

3.1.15 ABQ201 did not report receipt of TCAS – RA to ATS Unit. No vertical / lateral change observed during the course of flight on RADAR.

3.1.16 During the climb under TCAS–Resolution Advisory SVA9431 at FL358 came closer to PIA303 FL360 by 25.9NM. However, Standard Horizontal Separation (15NM) was not ensured between SVA9431 and PIA303 during the time when Standard Vertical Separation (1000 ft) did not exist.

3.1.17 SVA9431 was provided with traffic information about ABQ201 FL340 (though it was after the commencement of descent from FL370) initially maintained prescribed rate of descent (less than 1500 ft per minute). However, due to the repeated instruction to expedite descent SVA9431 could not maintain the prescribed rate of descent. Consequentially, increase in the rate of descent resulted activation of TCAS–RA.

3.1.18 Karachi ATC (ACC Radar North) repeatedly instructed SVA9431 to expedite descent without assigning the reason. However, the reason i.e. presence of potential conflict with PIA303 provided once SVA9431 climbed to FL358 under TCAS–RA. Had this traffic information provided earlier (i.e. while instructing to expedite) with appropriate caution for the presence of ABQ201 could provide SVA9431 better situational awareness and understanding and enabled to adjust her flight profile (vertical rate of descent), accordingly.

3.1.19 During the entire period of occurrence, the traffic were operating in the area of jurisdiction of ACC Radar East. Whereas, Air Traffic Services were being provided by ACC Radar North.

3.1.20 It has been revealed during the investigations that “ACC Sectors” have been revised and re-delineated and accordingly implemented without being approved by the Appropriate ATS Authority and / or without being promulgated & incorporated in AIP – Pakistan.

3.1.21 ICAO DOC 8168 Vol-3 (Aircraft Operations) para 3.3 states, “Pilots should use appropriate procedures by which an aero plane 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.**

3.1.22 ICAO Doc 4444 (PANS ATM) at para 5.2.1.4 states that “Where the type of separation or minimum used to separate two aircraft cannot be maintained, another type of separation or another minimum shall be established prior to the time when the current separation minimum would be infringed**.**

3.1.23 ICAO Doc 4444 (PANS ATM) provides Separation Minima Based on ATS Surveillance System at para 8.7.3 and 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 systemor sensor to accurately identify the aircraft position in relation to the centre of a position symbol, PSR blip, SSR responseand 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.

3.1.24 Pakistan CAA being the appropriate ATS Authority for the provisioning of ATS has prescribed ATS SURVEILLANCE SERVICES AND PROCEDURES applicable in Pakistan in AIP Pakistan at ENR 1.6–1.

3.1.25 ICAO DOC 9863 (Airborne Collision Avoidance System Manual) at para 4.1.3.2 states that, “ACAS generates RAs when aircraft are converging and the time to potential collision is short. The warning time varies between 15 and 35 s depending on the geometry and altitude of the encounter. Many nuisance RAs are generated when aircraft approach within 305m (1000ft) of their cleared level with high vertical rates (in excess of 7.6 m/s or 1500 fpm). The problem is worse where descending and climbing aircraft level off in the same horizontal vicinity and within 305m (1000ft) vertically of each other. Whenever possible, airspace design should separate the areas where climbing and descending traffic level off. Certification authorities and aircraft operators should consider the acceptability of autopilot manoeuvres that allow high vertical rates just before level off. **To avoid these unnecessary ACAS RAs, operational procedures should be published by States which recommend that pilots reduce the rate of climb/descent to a value between 2.5 and 7.6 m/s (500 and 1 500 ft/min)** within the last 305 m (1 000 ft) before reaching the assigned level (flight level or altitude) provided that this does not increase the flight crew’s work due to the need for manual leveling off. Such limitations do not apply when ATC issues a specific rate in the climb/descent clearance or instruction in order to establish or maintain separation.

3.2 Cause(s) of Occurrence

3.2.1 This incident of TCAS–RA occurred due to the excessive rate of descent by SVA9431 (inertial vertical rate of more than 3000 ft per minute) while descending from FL370 to FL350. This incident cannot solely be attributed to cockpit crew of SVA9431. Initial rate of descent was well within the prescribed / recommended rate of descent. However, Karachi ATC (ACC Radar North) over emphasized and repeatedly instructed SVA9431 to expedite her descent. Moreover, inappropriate traffic information also resulted in creating wrong or inadequate situational awareness in the cockpit.

3.2.2 This incident of TCAS-RA also resulted in loss of separation and infringed standard separation between SVA9431and PIA 303 which is solely attributed to Karachi ATC (ACC Radar North). It was the lack of situational awareness where Karachi ACC left with no other option but to take PIA303 on Radar Vector and that too was not enough to create Standard Horizontal Separation between SVA9431 and PIA303 during the time Standard Vertical Separation did not exist. The route segment between Rahim Yar Khan (OPRK) and Nawabshah (OPNH) is situated close to Indo-Pak International Boarder and vectoring towards East could have led to further adverse situation. Overemphasize and overdoing on the part of ACC Radar North controller is evident.

4. SAFETY RECOMMENDATIONS

4.1 Pakistan CAA (Operations Directorate) may issue directions to field ATS Units for adhering to the laid down procedure for the provisioning of Air Traffic Services (Vectoring/Traffic Information) in accordance with ICAO Doc 4444 and as described in AIP–Pakistan. Provisioning of Traffic Information shall be appropriate and timely as described at para 5.10.1.2 in ICAO Doc 4444 (PANS ATM) and para 3.3 of ICAO Doc 8168 Vol 3 (Aircraft Operation), where applicable.

4.2 Pakistan CAA (Operations Directorate) may issue necessary guidelines for incorporating relevant chapters / sections from ICAO Doc 9863, “Airborne Collision Avoidance System (ACAS) Manual”, to improve Curriculum for the On the Job Training of Radar Controllers specifically for ACC Radar Controllers.

4.3 Pakistan CAA (Operations Directorate) may also issue directions, as deemed appropriate, for utilizing ATM Simulators to create better situational / traffic awareness during the OJT. ACC Radar Controller may be assigned simulator training for the period / watches, as deemed appropriate, under a qualified On the Job Training Instructor. Concentrations may be put upon improvement of situational awareness and vectoring technique.

4.4 Pakistan CAA (Operations Directorate) shall process the case for the approval of appropriate ATS Authority for the revision of “ACC Sectors” in Karachi FIR and accordingly promulgate through AIP–Pakistan. Necessary directions, as deemed appropriate, for the continuation or otherwise cease of existing practice may also be issued.

4.5 Pakistan CAA (Civil Aviation Training Institute of CAA) in consultation with Operation Directorate may improve course curriculum(s) of relevant courses for ATCOs to include guidance material from ICAO Doc 9863 (Airborne Collision Avoidance System Manual) specifically revenant portion from **Chapter 3** and **Chapter 6** may appropriately be incorporated in class room trainings (curriculum / process) in Area Procedure / Area Radar control.

4.6 Pakistan CAA (Regulatory Division) may review and improve relevant pages of AIP–Pakistan (GEN 1.5-1 para 3 and ENR1.1-2 para 5) and appropriately incorporate the recommendations as contained in ICAO Doc 9863.