



सत्यमेव जयते

**FINAL INVESTIGATION REPORT
ON
SERIOUS INCIDENT INVOLVING
M/s SPICE JET'S B737-800 AIRCRAFT VT-SZN
AT SEYCHELLES ON 14 SEPTEMBER 2021**

**GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU**

FOREWORD

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an Accident/Incident shall be the prevention of accidents and incidents and not to apportion blame or liability. The investigation conducted in accordance with the provisions of the above said rules shall be separate from any judicial or administrative proceedings to apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.

Contents

GLOSSARY	1
SUMMARY.....	3
SYNOPSIS	4
1. FACTUAL INFORMATION	5
1.1 HISTORY OF FLIGHT	5
1.2 INJURIES TO PERSONS.....	6
1.3 DAMAGE TO AIRCRAFT.....	6
1.4 OTHER DAMAGE.....	6
1.5 PERSONNEL INFORMATION	6
1.5.1 PILOT IN COMMAND	6
1.5.2 CO PILOT	7
1.6 AIRCRAFT INFORMATION.....	8
1.7 METEOROLOGICAL INFORMATION	9
1.8 AIDS TO NAVIGATION.....	9
1.9 COMMUNICATIONS.....	10
1.10 AERODROME INFORMATION	10
1.11 FLIGHT RECORDERS.....	11
1.11.1 DIGITAL FLIGHT DATA RECORDER	11
1.12 WRECKAGE AND IMPACT INFORMATIO	14
1.13 MEDICAL AND PATHOLOGICAL INFORMATION.....	14
1.14 FIRE	14
1.15 SURVIVAL ASPECTS.....	14
1.16 TESTS AND RESEARCH	14
1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION.....	15
1.17.1 STABILIZED APPROACH CRITERIA	15
1.17.2 SOP FOR SEYCHELLES	16
1.18 ADDITIONAL INFORMATION	16
1.18.1 THRESHOLD MARKINGS	16
1.18.2 PRECISION APPROACH PATH INDICATOR	17
1.18.3 APPOINTMENT OF INVESTIGATOR-IN-CHARGE.....	17
1.18.4 CCTV CAMERA FOOTAGE	18
1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES	20
2. ANALYSIS.....	20
2.1 SERVICEABILITY OF AIRCRAFT	20
2.2 FLIGHT DATA ANALYSIS.....	20

2.3	CIRCUMSTANCES LEADING TO THE INCIDENT.....	22
3.	CONCLUSION.....	22
3.1	FINDINGS.....	22
3.2	PROBABLE CAUSE	23
4.	SAFETY RECOMMENDATIONS.....	23
	Appendix A.....	24
	Appendix B.....	25

GLOSSARY

AAIB	Aircraft Accident Investigation Bureau
AGL	Above Ground Level
AMSL	Above Mean Sea Level
AOM	Aerodrome Operating Minima
ARC	Airworthiness Review Certificate
ARP	Aerodrome Reference Point
ASDA	Accelerate Stop Distance Available
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATPL	Airline Transport Pilot License
CoA	Certificate of Airworthiness
CCTV	Closed Circuit Television
CVR	Cockpit Voice Recorder
CPL	Commercial Pilot License
DGCA	Directorate General of Civil Aviation
DFDR	Digital Flight Data Recorder
FCOM	Flight Crew Operation Manual
FDM	Flight Data Monitoring
FMC	Flight Management Computer
ft	Feet
fpm	Feet per minute
Hrs	Hours
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
kg	Kilogram
Kt	Knot
LDA	Landing Distance Available
LLZ	Localiser
m	Meters
MCP	Mode Control Panel
MEL	Minimum Equipment List
METAR	Meteorological Terminal Air Report
MSN	Manufacturer Serial Number
MTOW	Maximum Take Off Weight
NDB	Non Directional Beacon
OEM	Original Equipment Manufacturer

nm	Nautical Miles
PAPI	Precision Approach Path Indicator
PCN	Pavement Classification Number
PIC	Pilot in Command
RA	Radio Altitude
RESA	Runway End Safety Area
RWY	Runway
s	Seconds
SOP	Standard Operating Procedures
TAF	Terminal Area Forecast
TODA	Take-off Distance Available
TORA	Take-off Run Available
TWR	Tower
VOR	VHF Omni directional Range
VHF	Very High Frequency
UTC	Universal Time Coordinated

SUMMARY

Serious Incident involving M/s Spice Jet's B737-800 aircraft VT-SZN at Seychelles on 14 September 2021			
1.	Aircraft	Type	B737-800
		Nationality	Indian
		Registration	VT-SZN
		Country of Manufacture	U.S.A
2.	Owner	M/s Air Lease Corporation	
3.	Operator	Spice Jet	
4.	Pilot – in –Command	ATPL Holder	
	Extent of Injuries	Nil	
5.	Co-Pilot	CPL Holder	
	Extent of Injuries	Nil	
6.	Place of Incident	Seychelles International Airport (FSIA)	
7.	Co-ordinates of Incident Site	S04 40.11, E055 30.80	
8.	Last point of Departure	Chennai	
9.	Intended place of Landing	Seychelles	
10.	Date & Time of Incident	07 Sept 2021 at 09:02 UTC	
11.	Passengers on Board	137	
12.	Extent of Injuries	Nil	
13.	Crew on Board	02 Pilots, 04 Cabin Crew, 01 AME	
14.	Extent of Injuries	Nil	
15.	Phase of Operation	Landing	
16.	Type of Incident	Abnormal Runway Contact	

(All the timings in this report are in UTC unless otherwise specified)

SYNOPSIS

On 07 September 2021, M/s Spice Jet planned a flight for sector Chennai – Seychelles – Chennai with call sign SG-9909. The flight was a Charter Flight operated with a Boeing 737-800 type aircraft bearing registration VT-SZN.

The flight was operated by an ATPL holder PIC and a CPL holder Co-Pilot. The flight SG-9909 departed for the first leg (Chennai - Seychelles) at 04:53 UTC and took off at 05:03 UTC. While landing at Seychelles at about 09:02 UTC, the aircraft landed short of Runway 13 threshold. No damage was reported to aircraft or on ground. None of the crew or passengers were injured.

The occurrence was classified as a Serious Incident as per Aircraft (Investigation of Accidents and Incidents) Rules, 2017. Director General, AAIB appointed Shri Jasbir Singh Larhga, Deputy Director, AAIB as Investigator-in-Charge to carry out investigation into circumstances of the accident vide order no. INV-12011/3/2021-AAIB dated 11 Oct 2021, under Rule 11(1) of Aircraft (Investigation of Accidents and Incidents) Rules, 2017.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State having the responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.

1. FACTUAL INFORMATION

1.1 HISTORY OF FLIGHT

On 07 Sept 2021, M/s Spice Jet planned a flight for sector Chennai – Seychelles – Chennai with call sign SG-9909. The flight was a Charter Flight operated with a Boeing 737-800 type aircraft bearing registration VT-SZN.

The flight was operated by an ATPL holder PIC and a CPL holder Co-Pilot. They were assisted in the cabin by 04 Cabin Crew. One Aircraft Maintenance Engineer was flying as an Additional Crew Member on duty for certification in Seychelles. The flight was the first flight of the day for the flight crew and the aircraft was operating its second sector on the day. The crew had never operated any flight to Seychelles prior to this flight.

The flight SG-9909 departed for the first leg (Chennai - Seychelles) at 04:53 UTC and took off at 05:03 UTC. Co-pilot was pilot flying and PIC was pilot monitoring for take-off at Chennai. After obtaining destination weather, PIC took over controls and was pilot flying till touchdown at Seychelles Runway 13.

The flight was uneventful till approach. While descending into Seychelles Airport, as per the ATIS information winds were 130°/17Kt and visibility was more than 10 km. As winds were favourable for Runway 13, a visual approach for Runway 13 was carried out.

After being visual with runway and terrain, the crew descended the aircraft to circuit altitude in co-ordination with the ATC. Aircraft configuration and landing checklist was carried out as per the elected approach. Crew stated that speed calculations were carried out as per ATIS information, but actual speeds were maintained as per tower reported winds and speed callouts were made accordingly. Crew also stated to have encountered light drizzle during short finals. Aircraft landed on Runway 13. The ATC asked the flight to backtrack and vacate via "Taxiway B" to "Stand 2".

Post engine shut down, during post flight walk around an aerodrome official enquired from the PIC whether the aircraft had landed before displaced threshold. The PIC responded that the aircraft had landed within the touchdown zone.

However, a voluntary report was filed by the crew to the airline about the event on their return to Chennai. The airline carried out analysis of DFDR data and concluded that the aircraft had landed 180 feet short of threshold. Accordingly, mandatory reporting was done as per DGCA CAR Section 5, Series C, Part 1 and Aircraft (Investigation of Accidents and Incidents) Rules, 2017 to AAIB on 08 Sept 2022. The operating crew were also off-rostered by Spice Jet with immediate effect for investigation and corrective training.

DGCA ordered an Investigation into the occurrence under Rule 13 (1) of Aircraft (Investigation of Accidents and Incidents) Rules, 2017 on 20 Sept 2021. Later, on 11 Oct 2021 AAIB classified this occurrence as a Serious Incident and issued an order under Rule 11 of Aircraft (Investigation of Accidents and Incidents) Rules, 2017.

1.2 INJURIES TO PERSONS

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor	0	0	0
None	6	137	143

1.3 DAMAGE TO AIRCRAFT

Nil

1.4 OTHER DAMAGE

Nil

1.5 PERSONNEL INFORMATION

1.5.1 PILOT IN COMMAND

Nationality	Indian
Date of Joining the Airline	Dec 2012
Gender	Male
Age	32 Yrs
License	ATPL
Date of Issue of License	31 July 2017
Validity of License	30 July 2022
Type Endorsements	C-152A, PA-34, B737-700-900, MAX
Date of Class I Medical Exam	25 Jan 2021
Validity of Medical Exam	28 Jan 2022
Issue of FTRO License	19 Mar 2015
FTRO License Validity	18 Mar 2025
Total Flying Experience	6592:25 Hrs
Total Flying Experience on Type	6318:19 Hrs
Total Flying Experience as PIC on Type	2333:41 Hrs
Total Flying Experience during last 180 days	89:26 Hrs
Total Flying Experience during last 30 days	05:22 Hrs
Total Flying Experience during last 07 days	05:22 Hrs
Total Flying Experience during last 24 hours	Nil except incident flight

PIC had a rest period of 20:37 Hrs before operating Chennai-Seychelles-Chennai sector. He had completed his Annual Ground Training on 25 Sept 2020 and undergone his last Proficiency Check on 01 Sept 2021. After the incident the PIC was off-rostered and a corrective

training plan was proposed by the Airlines to DGCA for approval. After approval of DGCA, corrective training was carried out and the PIC was released for flying duties.

The details of any exceedance in flight parameters monitored on any flight operated by the PIC during the last 02 years was sought from the airlines. The airlines made details for year 2020 and 2021 available to AAIB. As per the details made available the PIC was involved in 03 events where exceedance in parameters was monitored by Airline in their Flight Data Monitoring Program. Same is shown in the following table:

S. no	Date	Exceedance	Limit	Recorded	Unit
1	7 Dec 20	High vertical acceleration (landing)	2.1	2.5	G
2	15 Feb 21	Low Rate of Descent (<1000 ft)	300	105	fpm
3	3 Sep 21	Long Landing	3000	3106	ft

Necessary counselling or corrective training was given to the PIC as per company policy for the above exceedance.

1.5.2 CO PILOT

Nationality	Indian
Date of Joining the Airline	July 2018
Gender	Female
Age	23 Yrs
License	CPL
Issue of License	19 Jan 2018
Validity of License	18 Jan 2023
Date of Class I Medical Exam	01 Sep 2021
Validity of Medical Exam	31 Aug 2022
Issue of FRT0 License	19 Jan 2018
FRT0 License Validity	18 Jan 2023
Total Flying Experience	1784:43 Hrs
Total Flying Experience on Type	1584:43 Hrs
Total Flying Experience during last 180 days	159:33 Hrs
Total Flying Experience during last 30 days	59:49 Hrs
Total Flying Experience during last 07 days	13:00 Hrs
Total Flying Experience during last 24 hours	Nil except Incident Flight
Rest period before flight	20:07 Hrs

The co-pilot had 20:07 Hrs of rest period before operating the Chennai-Seychelles-Chennai sector. She had completed her Annual Ground Training on 29 May 2021 and undergone her last Proficiency Check on 23 Jul 2021. After the incident the co-pilot was also off-rostered and a corrective training plan was proposed by the Airlines to DGCA for approval. After approval of DGCA, corrective training was carried out and Co-pilot was released for flying duties.

The details of any exceedance in flight parameters monitored on any flight operated by the PIC during the last 02 year was sought from the airlines. The airlines made details for year 2020 and 2021 available to AAIB. As per the details made available the co-pilot was involved in 04 events where exceedance in parameters was monitored by Airline in their Flight Data Monitoring Program. Same is shown in the following table:

S. no	Date	Exceedance	Limit	Recorded	Unit
1	14-Sep-20	High Rate of Descent (500ft to 100ft)	1200	1335	fpm
2	8-Feb-21	High Rate of Descent (500-100 ft)	1100	1170	fpm
3	24-Apr-21	Deviation Above Glideslope (<1000 ft)	1	1.36	d
4	27-Aug-21	High Rate of Descent (500-100 ft)	1100	1248	fpm
	27-Aug-21	Low Rate of Descent (<1000 ft)	300	0	fpm

Necessary counselling or corrective training was given to the Co-Pilot as per company policy for above exceedance.

1.6 AIRCRAFT INFORMATION

Boeing 737-800 is a subsonic, medium-range, civil transport aircraft. The aircraft is powered by two CFM International CFM56-7 high bypass turbofan engines on wing-mounted engine pods. The specified minimum cockpit crew to operate the aircraft is two.

The aircraft VT-SZN was manufactured by M/s Boeing Airplane Company, Seattle USA in June 2016. It is registered in India and bears MSN 41345. The aircraft was registered in India under ownership of M/s Air Lease Corporation and had a valid Certificate of Registration on the day of incident.

The Certificate of Airworthiness (CoA) issued on the aircraft was valid subject to validity of Annual Renewal Check (ARC). The last ARC was carried out on 11 Aug 2021 and was valid up to 11 Aug 2022. Aircraft was holding a valid Aero Mobile License at the time of incident. The aircraft had been configured by Spice Jet for passenger seating capacity of 189 in a single class configuration. It is certified in Normal category, for day and night operation under VFR & IFR conditions. The cruise ceiling of the aircraft is 41000 feet.

The aircraft was last weighed on 29 July 2021 at Chennai and the weight schedule was prepared and duly approved by DGCA. As per the approved weight schedule the Empty weight of the aircraft is 41050.03 Kg and Maximum Usable Fuel Quantity is 22137 Kg. Maximum payload with fuel tanks full is 14696.32 Kg. Empty weight CG is 658.88 inches aft of Datum. The next weighing is due on 28 July 2026. The maximum take-off weight of the aircraft was 79015 Kg. The weight and balance of the aircraft was within the operating limits.

The scrutiny of the Airframe Log book revealed that as on 7 September 2021, before operating the subject incident, the aircraft had completed 20,469:40 Hrs (TSN) and 8,581 landings (CSN). The aircraft was equipped with two CFM56-7B26E engines. Both engines were manufactured in April 2016 and had operated 20474:32 Hrs and 8582 Cycles before operating the incident flight.

The aircraft and its engines were being maintained as per the DGCA approved 'Aircraft Maintenance Program' consisting of calendar period/ flying hours or cycles. Last major inspection before the incident was carried out on 06 Oct 2019. Subsequently, all inspections (Pre-flight checks, Extended Transit, A Checks) were carried out as and when due before the incident.

No maintenance action was carried out post completion of the subject incident flight as no tech log entry was made by the PIC. However, after receiving the voluntary report from the operating pilots and confirming undershoot from DFDR, Hard Landing inspection was carried out and no abnormalities were found. As condition of the aircraft was found satisfactory, the aircraft was released for further flight.

1.7 METEOROLOGICAL INFORMATION

Weather as per TAF issued on 7 September 2021 at 0502 UTC was:

"TAF FSIA 070502Z 0706/0806 14015KT 9999 BKN022 BECMG 0709/0711 15015G25KT FEW 024"

Weather as per METAR issued on 7 September 2021 at 0900 UTC was:

"METAR FSIA 070900Z 12017G28KT 8000SHRA FEW012 BKN016 28/23 Q1012 TEMPO 500"

As per the Met Report issued on 7 September 2021 at 0900 UTC:

"MET REPORT FSIA 070900Z WIND RWY13 TDZ 110/20KT END 140/22KT VIS RWY 13 TDZ 8KM END 10KM MOD SHRA CLD FEW 1200FT BKN 1600FT T28 DP23 QNH 1012HPA QFE RWY 13 1012HPA TREND TEMPO VIS 5KM"

As per the reported weather conditions winds were from 120 degrees (east-southeast) at 17 Kt gusting up to 28 Kt Minimum Horizontal visibility was 8000 m in rain showers, outside air temperature of 29° Celsius and sea level pressure was 29.88 inches Hg. At 08:54:04 UTC the winds reported by ATC to SEJ9909 was 130 degrees 17 Kt.

1.8 AIDS TO NAVIGATION

Following Navigation Aids are available at Seychelles International Airport (FSIA) as per the AIP.

Type of aid, CAT of ILS/MLS (For VOR/ILS/MLS, give VAR)	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME tx antenna	Remarks
1	2	3	4	5	6	7
LLZ ¹ & ² Uncategorised	SIA	110.3MHZ	H24	04 39 55. 30 S 055 30 32.47 E		1.58NM from THR RWY 31.DOC; 25 NM
GP ¹		335MHZ	H24	04 40 51.81 S 055 31 47.92 E		Angle 3°. Antenna not located at required distance prior THR RWY 31.
DME ¹	SIA	CH40X	H24	04 40 51.82 S 055 31 47. 93 E	5(m) 16.40(ft.)	Frequency paired with ILS LLZ. Reading zero at THR RWY 31. Coverage: 60NM
En-route DVOR/DME	PRA	115.7 MHZ/ CHI04X	H24	04 18 26.52 S 055 42 25.44 E	300 M	DOC; 200 NM radius from PRA

1.9 COMMUNICATIONS

VT-SZN came in for handover to Seychelles TWR on VHF frequency 118.3 Mhz at about 08:53:41 UTC. The aircraft maintained positive contact with ATC till end of the flight. The transcript of relevant communication with ATC is tabulated below:

Time (UTC)	Caller	Narrative
08:53:41	SEJ9909	SEYCHELLES SIERRA ECHO JULIET NINER NINER ZERO NINER ON HANDOVER
08:53:54	TWR	SIERRA ECHO JULIET NINER NINER ZERO NINER SEYCHELLES TOWER GO AHEAD
08:53:58	SEJ9909	SIERRA ECHO JULIET NINER NINER ZERO NINER APPROACHING SIX THOUSAND FEET QHN ONE ZERO ONE TWO ON VISUAL APPROACH FOR RUNWAY ONE THREE
08:54:04	TWR	SIERRA ECHO JULIET NINER NINER ZERO NINER CLEAR TO JOIN AND REPORT LEFT BASE RUNWAY ONE THREE QNH ONE ZERO ONE TWO, SURFACE WIND, ONE THREE ZERO, ONE SEVEN KNOTS
08:59:04	TWR	<i>Winds one three zero, one fiver knots communicated to outgoing aircraft.</i>
09:00:07	SEJ9909	APPROACHING FINAL RUNWAY ONE THREE SPICE JET NINER NINER ZERO NINER
09:00:11	TWR	SIERRA ECHO JULIET NINER NINER ZERO NINER RUNWAY ONE THREE, SURFACE WIND ONE TWO ZERO, TWO FIVER KNOTS YOU'RE CLEAR TO LAND
09:01:28	TWR	<i>Winds one three zero, two zero knots communicated to outgoing aircraft.</i>
09:02:19	TWR	SPICE JET NINER NINER ZERO NINER, ONE EIGHTY BACKTRACK, VACATE VIA BRAVO STAND NUMBER TWO
09:02:25	SEJ9909	CONFIRM WE CAN DO ONE EIGHTY FROM PRESENT POSITION? SPICE JET NINER NINER ZERO NINER

1.10 AERODROME INFORMATION

Seychelles International Airport is located on the island of Mahe, about 9.6 km south-east from the capital city of Victoria in Seychelles. It is situated on a coastal, hilly island in the Indian Ocean. There are undulating terrains, nearly 1800-3000 feet high, on south-west side of the runway. The IATA code for the airport is SEZ and ICAO code for the airport is FSIA. The Airport Elevation is 12 feet (3.65m) and the ARP coordinates are S 04° 40'27.64" E 055° 31' 18.67".

Runway characteristics and distances are shown in the following tables.

Runway Physical Characteristics					
Runway Designator	Threshold Co-ordinates	Runway Dimensions(m)	Strip Dimension(m)	Clearway Dimension(m)	Threshold Elevation(m)
13	04°40'05.49"S 055°30'47.03"E	2987 X 46	3110 X 152	1493 X 180	3.05
31	04°40'49.78"S 055°31'50.30"E	2987 X 46	3110 X 152	610 X 180	3.05

Pavement Classification Number (PCN) for both runway is PCN 72 /R/B/W/U Concrete.

Runway Declared Distances				
Runway Designator	Take-off Run Available (TORA) (m)	Take-off distance available (TODA) (m)	Accelerate stop distance available (ASDA) (m)	Landing Distance Available (LDA) (m)
13	2987	4480	2987	2682
31	2987	3597	2987	2682

LDA for runway 13/31 is reduced to 2682 M due to runway thresholds being displaced by 305 M for both runways. TODA RWY 13 represents 1½ runway length as departure path is over the sea. Details of approach and runway lighting available at Seychelles is as below:

FSIA AD 2.14 APPROACH AND RUNWAY LIGHTING

RWY Desig-	APCH LGT type LEN INSTS	THR LGT colour WBAR	VASIS (MEHT) PAPI	TDZ, LGT LEN	RWY Centre Line LGT Length, spacing colour, INTST	RWY edge LGT LEN, spacing colour INTST	RWY End LGT colour WBAR	SWY LGT LEN (M)	Remark
1	2	3	4	5	6	7	8	9	10
13	SALS ¹ RAIL 427M LIH	Green ²	PAPI ³ 3°	Nil	Nil	2682M 60M White, LIH ⁴	Red	Nil	Coastal Hazard Beacon ⁵
31	SALS 427M LIL	Green ²	PAPI ³ 3°	Nil	Nil	2682M 60M White, LIH ⁴	Red	Nil	

For RWY 13/31, Precision Approach Path Indicators (PAPI) are installed on the left side and assists by providing visual glide slope guidance in non-precision approaches environment. They are calibrated to indicate a 3.0° glide path to the runway. Runway 13 is offset to NE and must not be used when more than 2.6NM from the Runway, due to intervening high ground to the right of the approach path.

1.11 FLIGHT RECORDERS

The aircraft VT-SZN was equipped with Flight Data Recorder and Cockpit Voice Recorder in accordance with CAR Section 2, Series I, Part V. The DFDR data of the incident flight was made available for investigation. However, CVR was not replaced at Seychelles and thus, the CVR data of the Chennai-Seychelles flight was overwritten and was not available for investigation.

1.11.1 DIGITAL FLIGHT DATA RECORDER

The DFDR data was provided by the airline to AAIB. Airline had also shared the DFDR data of the incident flight with the OEM to get better estimate of the position of aircraft at wings level and touchdown point.

Time history plots of the pertinent longitudinal and lateral-directional parameters are attached as Appendix A and Appendix B, respectively. The time parameter in seconds along

the x-axis of these figures represents the elapsed time from an arbitrary point initialized prior to take-off.

As per the DFDR data the aircraft was established on a flaps 30 approach to Seychelles Runway 13 with autopilot and auto-throttle engaged. The mode control panel (MCP) selected speed was set to 153 knots, which was 6 knots above the recorded landing reference speed (V_{REF}) of 147 knots.

As per DFDR data, at 300 feet radio altitude (RA), the recorded winds were out of the east southeast (from approximately 133 degrees true heading) at an average speed of 21 Kt. Given the runway true heading of 125 degrees, the airplane would have been experiencing a headwind of 21 Kt and crosswind from the right of 3 Kt.

At time 14,890 s from an arbitrary point, the auto-throttle became disengaged near RA of 580 ft. About two seconds later the autopilot channel A became disengaged near RA of 565 ft. During transition from automation to manual, Rate of Descent was arrested between 500 ft AGL to 432 ft AGL recording minimum value of 160 fpm. Rate of Descent increased thereafter till 150 ft AGL, touching a peak value of 912 fpm.

Between 14,853 s and 14,923 s, the airplane turned left from a magnetic heading of near 195 degrees to approximately 130 degrees to align with the runway heading and at 14,923 s, the airplane was approximately aligned on the runway heading with wings near level. Aircraft was observed to be lower than the ideal altitude at wings level on final leg of the visual approach. The aircraft was at RA 50 ft while at position "S04 40.0, E055 30.66" as per FMC position data and touched down with landing G of 1.2 G (Initial NLF) and registered Peak NLF of 1.5 G.

The OEM estimated the initial touchdown at 14,945.5 s with right main gear contact first at a computed airspeed of around 147 Kt ($V_{REF}+0$), vertical speed of approximately 260 feet per minute (4.3 feet per second), pitch attitude of near 3.5 degrees and bank angle near 1 degree (right wing down).

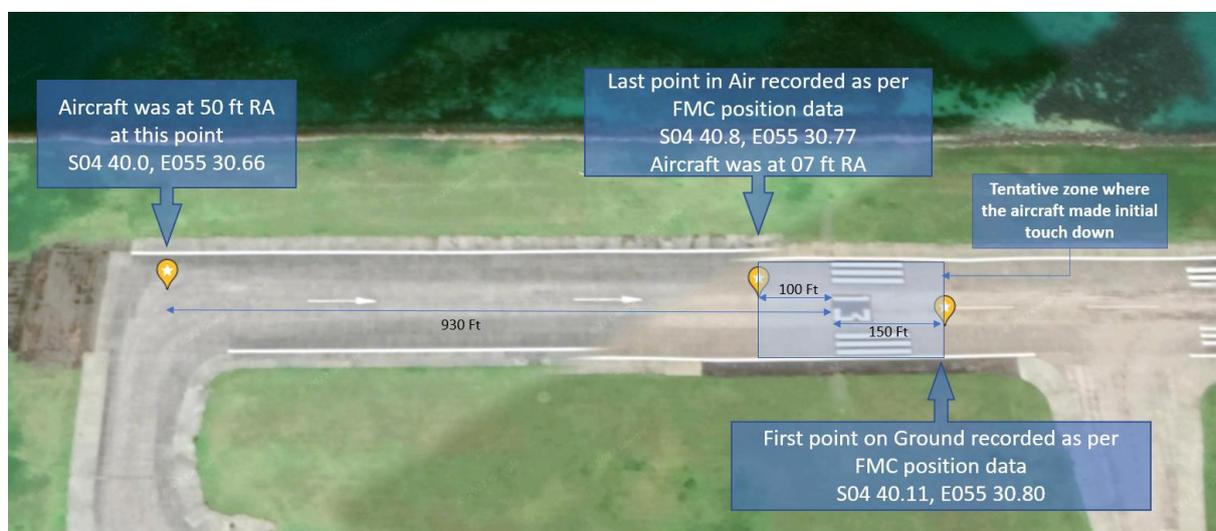


Figure 1: Tentative area of initial touchdown based on FMC Position Data

The last "In-Air" position recorded as Flight Management Computer (FMC) position data was "S04 40.8, E055 30.77". The first "On-Ground" position recorded as per FMC position data

was “S04 40.11, E055 30.80” at about 09:01:59 UTC. The last “In-Air” point “S04 40.08, E055 30.77” is about 100 feet before threshold, but initial touchdown position was erroneously estimated to be 180 feet before the threshold by the Airlines and reported to DGCA and AAIB.

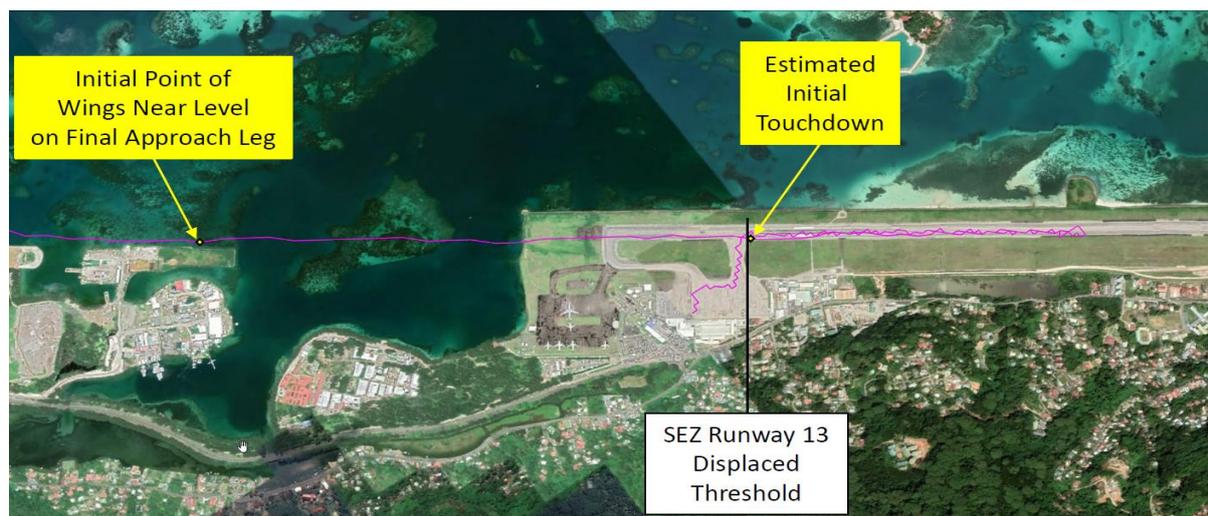


Figure 2: Ground Track based on Flight Management Computer position data

However, later the airline approached the OEM to provide DFDR analysis to get better estimate of the position of aircraft at wings level and touchdown point.

OEM carried out Ground Track Analysis and a ground track was generated to show the airplane’s path during the approach, landing, and taxi based on the recorded FMC latitude and longitude airplane position parameters (Figure 2). Runway 13 at Seychelles has a length of 9,800 feet and a width of 151 feet. The aircraft was approximately 5,205 feet (1,587 meters) from the Runway 13 displaced threshold with the wings nearly level (bank angle near zero degrees) on the final approach leg

The initial touchdown point was estimated to be approximately 8 feet (2.4 meters) beyond the Runway 13 displaced threshold by the OEM based on the recorded FMC latitude and longitude parameters.

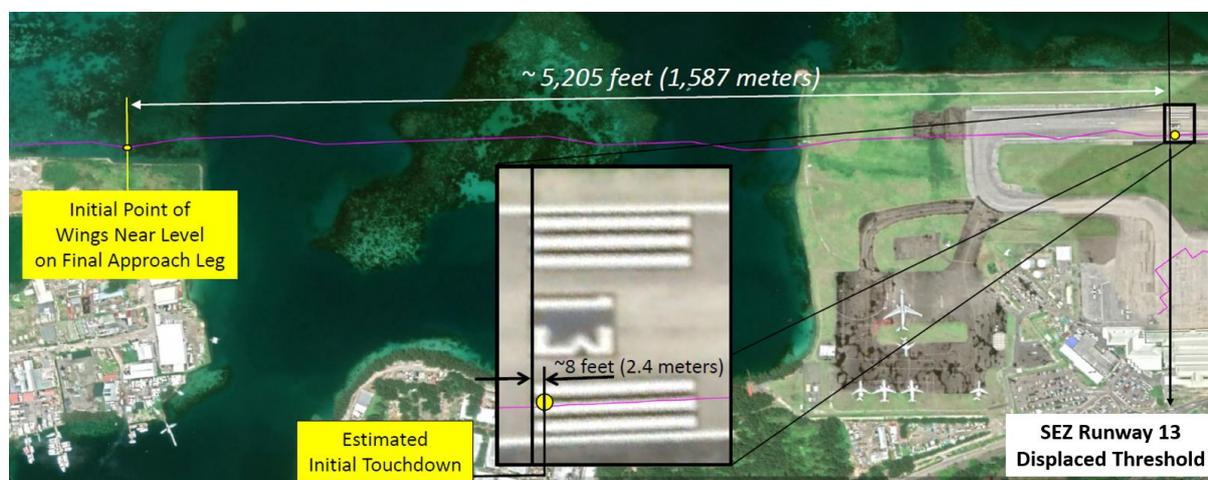


Figure 3: Initial Touchdown estimated by OEM to be 08 ft beyond Threshold

The touchdown point was estimated by OEM through interpolation and the figure is influenced by the following factors:

1. Position accuracy
2. Uncertainty in Airplane distance travelled between recorded position and touchdown determination

The location of touchdown point estimated by ground track analysis may have combined error of up to ~100 feet. Further, the FMC position recorded in DFDR is aligned to GPS antenna position at power up. The FMC position is then updated throughout the flight with inputs from a variety of sensors.

The GPS antennas are located near Station 500A, approximately 29 ft forward of the main landing gear. An additional offset of 29 ft between the nominal aircraft reference for the recorded latitude/longitude position data and the landing gear is also not factored in the figure of 08 ft provided by the OEM.

1.11.2 COCKPIT VOICE RECORDER

As per their statement, the operating crew did not suspect that the aircraft had landed before the displaced threshold. Neither was any communication made to the crew in this regard by ATC. Because of an enquiry by an Aerodrome Official, crew filed a voluntary report on their arrival at Chennai.

As the flight from Seychelles - Chennai was more than 4 hrs, the recordings of the Chennai - Seychelles flight were overwritten and incident portion could not be retrieved.

1.12 WRECKAGE AND IMPACT INFORMATION

There was no damage either to aircraft or any other object.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

As per prevalent regulations, operating cockpit crew had given the undertaking that they are not under any influence of alcohol/psychoactive substance in last 12 hrs from the time of reporting for the duty.

Additionally, the PIC had also undergone random preflight Breath Analyzer test and was tested negative.

1.14 FIRE

Not relevant to this investigation.

1.15 SURVIVAL ASPECTS

The serious incident was survivable / none of the passengers or crew were injured.

1.16 TESTS AND RESEARCH

Not relevant to this investigation.

1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION

Spice Jet is an Indian commercial air operator headquartered in Gurgaon, Haryana. It operates a fleet of Boeing 737 NG/MAX and Bombardier Q400 aircraft to Indian and international destinations.

Spice Jets holds a DGCA issued Air Operator Permit (AOC # S-16), issued on 17 May 2005 in Passenger and Cargo Category which was last revised on 01 Oct 2020. The Air Operator Permit is valid till 16 May 2023. Spice Jet employs competent management personnel in key positions on a full-time basis in accordance with DGCA requirements.

The DGCA approved / nominated post holders supervise the flight operations, training, security, inflight services, flight safety, maintenance, engineering, operations, ground handling, quality control, line flying etc. within the scope of their charter of duties as mentioned in para A1.1.7 of their operations manual. The organization has prepared an operations manual based on the existing regulations which is duly approved by DGCA. The operator carries out its own maintenance as a CAR 145 approved organization.

1.17.1 STABILIZED APPROACH CRITERIA

The Stabilized approach criteria used by the Airline is quoted below:

“An approach is considered stabilized when all the following criteria are met:

- a. The aircraft is on the correct lateral and vertical flight path.*
- b. Only small changes in heading and pitch are required to maintain correct flight path.*
- c. The aircraft speed is not greater than $V_{APP} + 10$ knots and / or not lower than $V_{APP} - 5$ knots.*
- d. Only as a consequence of particular speed instructions by ATC, a deviation from the Stabilised Speed criteria including the associated thrust setting is permitted below 1000 feet AFE down to 500 feet AFE. In this case, the Stabilised Speed criteria and the associated thrust setting must be reached by 500 feet AFE latest.*
- e. The aircraft is in the correct landing configuration.*
- f. Rate of decent is not greater than 1000 fpm. If an approach requires a rate of decent greater than 1000 fpm, a special briefing shall be conducted.*
- g. Power / Thrust setting is appropriate for the aircraft configuration as defined in the relevant aircraft type FCOM/AOM.*
- h. All briefings and checklists have been completed.*
- i. Instrument landing system (ILS) approaches shall be flown within one dot of the glideslope and localizer.*

Note: Flying Stabilized approach does not preclude flying a delayed flaps approach (decelerated approach) to comply with ATC instructions.

- j. 360 degree turns during the final approach phase are prohibited below”*

Spice Jet in accordance with their Flight Data Monitoring program analysed the data for any exceedance in flight parameters and observed the parameters to be within limits prescribed in DGCA approved Flight Safety Manual.

1.17.2 SOP FOR SEYCHELLES

Airlines had a published SOP for operations into Seychelles. As per the SOP, the aerodrome was classified as Category B Aerodrome and only Self Briefing was required for operations to Seychelles. The SOP also laid down special qualification for operating to Seychelles as shown in the following table.

Crew	Experience on Type [in Hours]	Briefing Required	Simulator Training [in Hours]	Observation Flight	Route Check	Remarks
P1	1000 hours	Self-briefing (Cat B aerodrome)	Nil	Nil	Nil	
P2	500 hours	Self-briefing (Cat B aerodrome)	Nil	Nil	Nil	

The company SOP did not have information about displaced threshold, absence of transverse stripe on displaced threshold, difference in runway marking from Pattern A and B defined in Annex 14 commonly prevalent in India etc. The SOP also did not have procedure for conducting visual approach in absence of Straight-in Instrument Approach for Runway 13.

1.18 ADDITIONAL INFORMATION

1.18.1 THRESHOLD MARKINGS

Threshold markings as per standard defined in Chapter 5 of ICAO Annex 14 are depicted below:

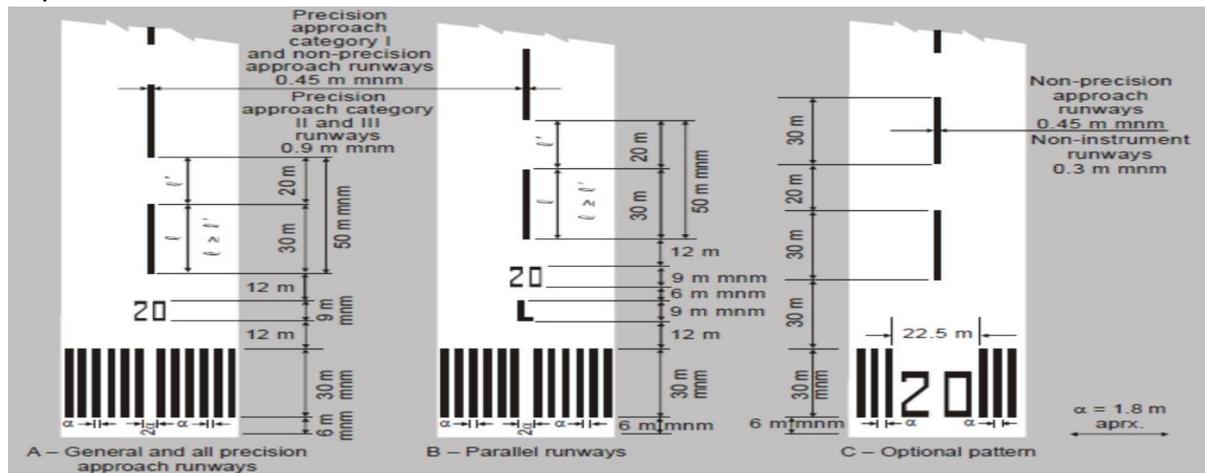


Figure 4: Threshold markings as per standard defined in Chapter 5 of ICAO Annex 14

Seychelles airport follows pattern C shown in the above image whereas most of the airport in India where Spice Jet operates follow pattern A and B shown in the above image.

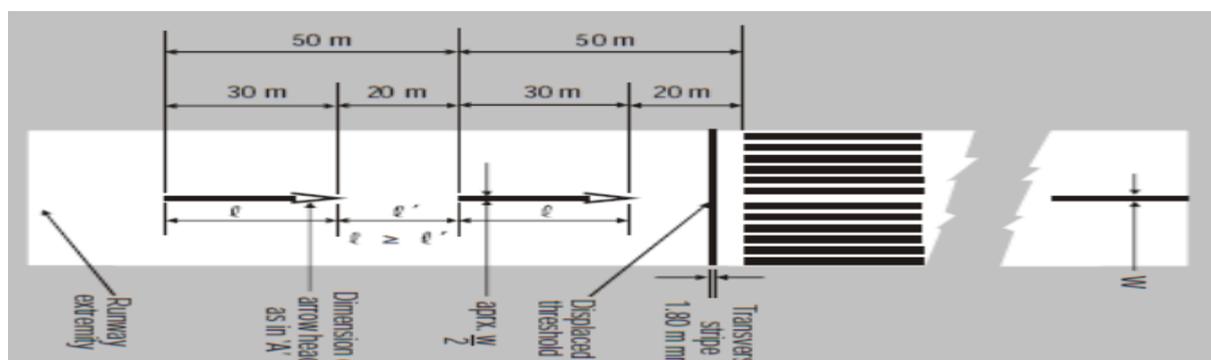


Figure 5: Transverse Stripe

Further, as per recommendations contained at Para 5.2.4.7 of ICAO Annex 14, where a threshold is displaced from the extremity of a runway or where the extremity of a runway is not square with the runway centre line, a transverse stripe as shown in the Figure 5 should be added to the threshold marking.

The threshold markings at Seychelles did not have the recommended Transverse Stripe marking, but was otherwise compliant with standards of ICAO Annex 14.

1.18.2 PRECISION APPROACH PATH INDICATOR

The Precision Approach Path Indicator (PAPI) lights are a single row of lights normally positioned beside the runway on the left side. The PAPI landing geometry is shown in the figure below.

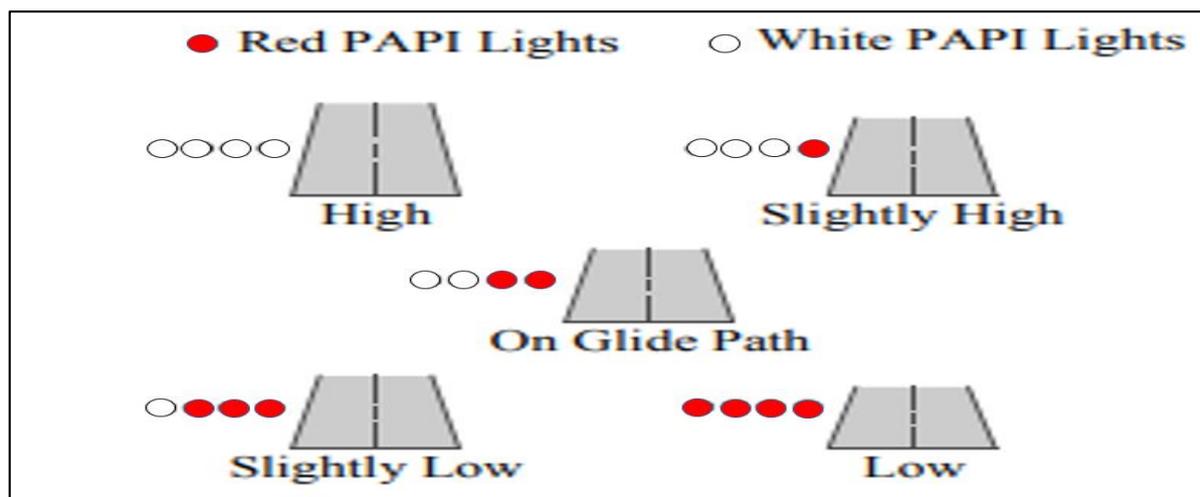


Figure 6: Precision Approach Path Indicator landing geometry

They provide a visual guidance to the pilot in non-precision approaches as indication of their aircraft's position relative to the correct glide path for the runway. The lights are colour-coded and are typically placed approximately 300 metres from the landing threshold of the runway on the left-hand side. When the airplane is on a normal 3° glide path, the pilot sees two white lights on the left and two red lights on the right. Light combinations as per Figure 6 above indicate when aircraft is slightly high, high, slightly low and low.

1.18.3 APPOINTMENT OF INVESTIGATOR-IN-CHARGE

In accordance with Aircraft (Investigation of Accidents and Incidents) Rules, 2017 the Operator notified AAIB about the occurrence on 8th Sept 2022 after receipt of Voluntary Report from the crew in the night of 07th Sept 2022. AAIB sought details from the Operator and enquired with Seychelles Authorities about their intent to investigate this incident as a State of Occurrence. However, there was lack of coordination with DGCA on the matter and in the meanwhile DGCA ordered Investigation under Rule 13 of above said rules.

The occurrence was later classified as Serious Incident and Investigation was ordered by AAIB on 11 October 2021. Investigation being conducted by DGCA was closed and evidences were handed over to AAIB in due course.

1.18.4 CCTV CAMERA FOOTAGE

CCTV camera footage of landing was made available by the Seychelles Authorities. The screenshots from the CCTV footage are shown in the figures below. The threshold is close to the tail of aircraft parked in the apron.



Figure 7: Frame from CCTV footage showing VT-SZN approaching runway 13

The Figure 8 below shows the frames from CCTV footage while the aircraft flared very close to the runway surface.



Figure 8: Frames from CCTV footage showing aircraft flare close to runway surface



Figure 9: Frames from CCTV footage showing aircraft having touched down.

The images in Figure 9 shows aircraft having touched down. The images are not very clear but it is apparent that the aircraft wheels have touched down very close to the threshold, short of threshold. Due to the time lag between wheels touching the runway surface and generation of weight on wheels signal, the first on-ground position was recorded in DFDR when the aircraft was about 150 feet ahead of threshold.

As per the Airside Control & Management Center personnel at Seychelles Airport, the aircraft touched down at location marked by a yellow triangle in the figure below. The yellow star in the image shows the location of aircraft seen parked in the CCTV footage.



Figure 10: Likely touchdown point as informed by Airport personnel

1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES

Not relevant to this investigation.

2. ANALYSIS

2.1 SERVICEABILITY OF AIRCRAFT

The aircraft was maintained as per the Aircraft Maintenance Program approved by the DGCA. There was no record of any snag or deferred maintenance action that could have contributed to the incident.

From the DFDR recording of SG-9909 also it was concluded that the aircraft and all its system were serviceable and airworthy. There was no maintenance due on the aircraft as on date of incident. The inspections carried out on aircraft after voluntary report was filed did not reveal any abnormality. Aircraft serviceability was not a factor in this incident.

2.2 FLIGHT DATA ANALYSIS

DFDR analysis reveals that Auto-throttle was disengaged at about 580 ft and Autopilot channel A was disengaged at about 565 ft. Rate of Descent was arrested between 500 ft and 432 ft AGL and reached 160 fpm. Rate of Descent increased thereafter and reached a peak of 912 fpm at 150 ft AGL before being corrected again. The aircraft was flown low on final segment of visual approach with average rate of descent maintained higher than required till 150 ft AGL. The incident flight data was also analysed for any exceedance in flight parameters by Spice Jet in accordance with their Flight Data Monitoring program. As per the airline, the observed parameters were found to be within limits prescribed in DGCA approved Flight Safety Manual.

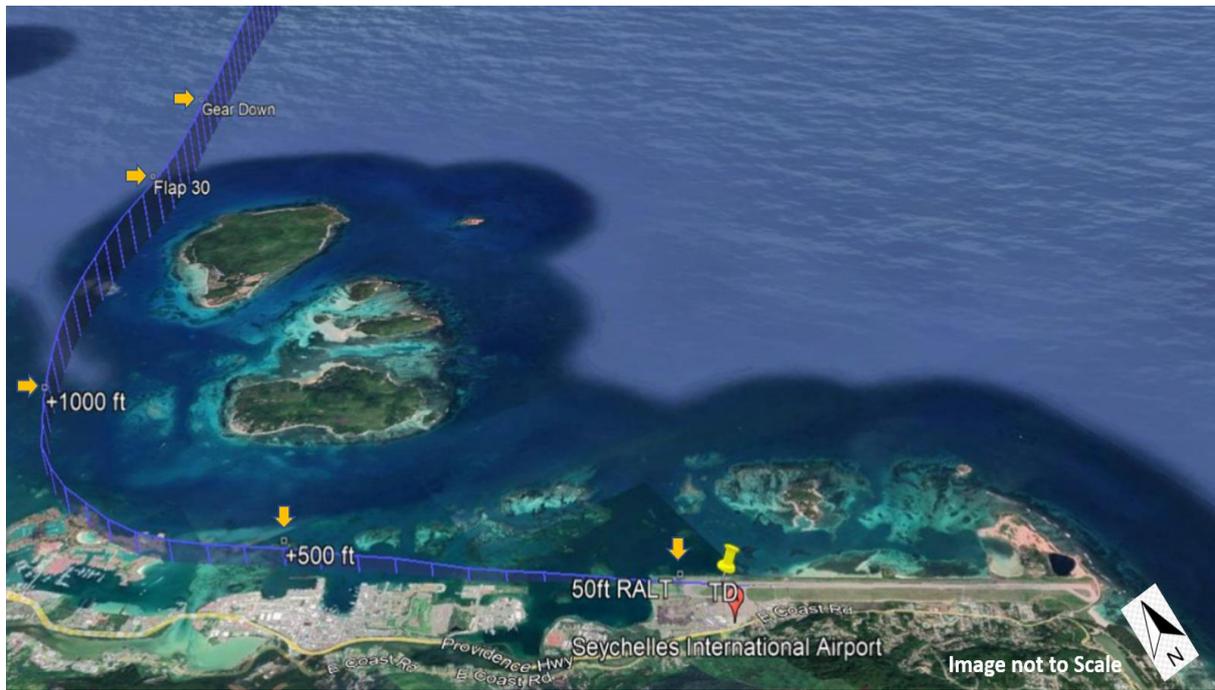


Figure 11: Flight track showing approach to Seychelles

The Flight Crew carried out a Visual Approach as required by their SOP and while doing so directly joined the Base Leg of the Visual Pattern. The Flight Crew established the Landing Configuration while on Base Leg and eventually turned Finals after carrying out all related Checklists. The Flight Crew turned Finals at approximately 509 ft (RA 556 ft) while aircraft was about 2.36 nm approximately from the runway threshold. Aircraft was observed to be lower than the ideal altitude at wings level on final leg of the visual approach. The aircraft was at RA 50 ft at position “S04 40.0, E055 30.66” as per FMC position data. This position corresponds to the start of the paved area of runway. From DFDR analysis it is evident that the aiming point which was mandatorily required to be established was judged incorrectly.

The last in air point recorded as per FMC position data was “S04 40.08, E055 30.77” which is about 100 feet before threshold. The first on-Ground position recorded as per FMC position data was “S04 40.11, E055 30.80”.

The airline erroneously calculated the touchdown to be 180 feet before the threshold, but later approached OEM for better estimates. Using interpolation, the initial touchdown point was estimated to be approximately 8 feet (2.4 meters) beyond the displaced threshold of SEZ Runway 13 based on the recorded FMC latitude and longitude parameters.

However, the methodology followed by the OEM is influenced by the position accuracy and uncertainty in aircraft distance travelled between recorded position and touchdown determination and can have error of up to ~100 feet. Further, an offset of 29 ft between the nominal aircraft reference for the recorded latitude/longitude position data and the landing gear was also not factored in touchdown point estimated using above methodology. Owing to the limitations of the software and methodology used, the figures cannot be taken as accurate estimates of the touchdown point.

The CCTV footage although not very clear, shows aircraft in a flare very close to ground and touching down just before the threshold and confirms the witness account.

2.3 CIRCUMSTANCES LEADING TO THE INCIDENT

The flight was a chartered flight operated by Spice Jet as per their SOP for operations to FSIA, Seychelles. As per the SOP, the Aerodrome was a Category B Aerodrome and hence only self-briefing was required. The crew had never operated to Seychelles before this flight but were meeting the experience requirement laid in the SOP. The SOP did not have various information that could have assisted crew in operating to an unfamiliar airfield.

The threshold markings at Seychelles were as per the Optional Pattern defined in Chapter 5 of ICAO Annex 14 which is not common at Indian Airports where Spice Jet regularly operates. The markings also did not have transverse stripe recommended in Annex 14. In challenging visual conditions, this marking can be mistaken to be aiming point by the crew not familiar with the marking.

Landing configuration was established after crew joined Base Leg of Visual Approach. Auto-throttle was disconnected for the approach. V_{APP} was selected based on winds reported by ATC and was set at 153 Kt, which was lower than the 156 Kt recommended for winds 130 degree/17 Kt. Aircraft encountered headwinds of 15-20 Kt on finals.

The flight turned finals at approximately 506 ft AGL while it was about 2.36 nm approximately from the runway threshold. Ideally, the aircraft should have been above 750 ft at this point to be able to follow the 3° profile. The RoD was higher than required till RA 150 ft but was corrected thereafter.

Being low on profile, the crew were not able to make correct visual assessment of the runway environment which was also influenced by their unfamiliarity with the runway. The aircraft landed slightly short of runway and same was confirmed from CCTV footage and information provided by Airport Personnel.

3. CONCLUSION

3.1 FINDINGS

- 3.1.1 The Certificate of Airworthiness, Certificate of Registration and Airworthiness Review Certificate of the aircraft were valid on the date of incident and the aircraft was airworthy.
- 3.1.2 Flight crew were medically fit and their licences were current to operate the flight.
- 3.1.3 Reported visibility was 10 km, however, crew stated to have encountered light drizzle during landing, which may have hampered their visual assessment on finals.
- 3.1.4 RWY 13/31 in FSIA Seychelles has a threshold displaced on both ends by 1000 ft. Crew was aware of displaced threshold.
- 3.1.5 The Runway Threshold Markings used in Seychelles was an alternate marking permitted by Annex 14, which is not predominantly used in India. This information was not part of the airline's SOP for operations to Seychelles.

- 3.1.6 As per the AIP, the Precision Approach Path Indicator (PAPI) for Runway 13 is offset to NE and must not be used when more than 2.6 nm from the runway due to intervening high ground to the right of approach path. The aircraft was wings level at about 2.36 nm but crew did not follow the PAPI while approaching runway.
- 3.1.7 V_{APP} was selected less than recommended value and RoD was maintained higher than required for a portion of approach till 150 ft AGL.
- 3.1.8 The flight crew went ahead to complete the return sector without removal/downloading of CVR, which resulted in non-availability of the CVR recording.
- 3.1.9 Flight crew were not able to not notify the company from Seychelles regarding “Landing short on Runway 13” at Seychelles, but a Voluntary Report was filed on return to Chennai on the same night.

3.2 PROBABLE CAUSE

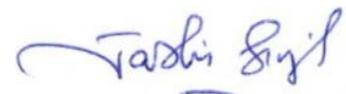
The Probable Cause of the Serious Incident was:-

- Crew’s unfamiliarity with the Aerodrome and lack of updated information in the SOP.
- In-adequate visual assessment of runway environment.
- Poor monitoring of PAPI guidance to correct the vertical profile.

4. SAFETY RECOMMENDATIONS

- 4.1 Operator should carry out safety risk assessment and ensure that adequate details of Hazards and Risks at the aerodromes are made available to the crew operating charter flights to new locations.
- 4.2 The airline should re-emphasise the importance of adherence to Standard Operating Procedures to its Pilots.
- 4.3 In view of corrective training already imparted to the Flight Crew of the incident flight, no further training or corrective action for crew is recommended.

Date: 22 Sept 2022



(Jasbir Singh Larhga)
Investigator-in-Charge

