الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY

United Arab Emirates

Air Accident Investigation Sector

Incident

- Final Report -

AAIS Case Nº: AIFN/0008/2019

Aircraft Struck Runway Edge Lights on Landing

Operator:	Etihad Airways
Make and Model:	Airbus A320-232
Nationality and Registration:	The United Arab Emirates, A6-EIT
Place of Occurrence:	Calicut International Airport (VOCL)
State of Occurrence:	The Republic of India
Date of Occurrence:	20 June 2019

This Investigation was conducted by the Air Accident Investigation Sector of the United Arab Emirates pursuant to Civil Aviation Law No. 20 of 1991, in compliance with Air Accident and Incident Investigation Regulations, and in conformance with the provisions of Annex 13 to the Convention on International Civil Aviation.

This Investigation was conducted independently and without prejudice. The sole objective of the investigation is to prevent future aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

The Air Accident Investigation Sector issued this Final Report in accordance with national and international standards and best practice. Consultation with applicable stakeholders, and consideration of their comments, took place prior to the publication of this Report.

The Final Report is publicly available at:

http://www.gcaa.gov.ae/en/epublication/pages/investigationReport.aspx

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Occurrence Brief

AAIS Case Nº:	AIFN/0008/2019
Operator:	Etihad Airways
Aircraft make and model:	Airbus A320-232
Registration mark:	A6-EIT
Manufacturer serial number:	5791
Number and type of engines:	Two, IAE V2527-A5 Turbofan engines
Date and time (UTC):	20 June 2019, at 2340 UTC
Place:	Calicut International Airport, India
Category:	Transport (Passenger)
Persons on-board:	124
Injuries:	Nil

Investigation Process

The occurrence involved an Airbus A320-232 aircraft, registration A6-EIT, and was notified by the operator to the Air Accident Investigation Sector (AAIS) by phone call to the Duty Investigator Hotline Number +971 50 641 4667. The India Aircraft Accident Investigation Bureau (AAIB), as the investigation authority of the State of Occurrence, delegated the investigation to the AAIS as the investigation authority of the State of Registry and the State of the Operator.

The occurrence was classified as a 'serious incident' after the initial investigation phase. However, the occurrence was then re-classified to as ‘incident’ based on the severity.

The scope of the investigation into this incident is limited to the events leading up to the occurrence safety concerns that may not have been contributory to the Incident but are significant in adversely affecting safety.

Notes:

1 Whenever the following words are mentioned in this Final Report with the first letter capitalized, they shall mean the following:

- (Aircraft) – the aircraft involved in this incident
- (Commander) – the commander of the incident flight
- (Co-pilot) – the co-pilot of the incident flight
- (Incident) – this investigated incident referred to on the title page of this Report
- (Investigation) – the investigation into this incident
- (Operator) – Etihad Airways (operator of the aircraft)
- (Report) – this incident investigation Final Report.

2 Unless otherwise mentioned, all times in this Report are 24-hour clock in Coordinated Universal Time (UTC), (UAE Local Time minus 4).

3 Photos and figures used in this Report are taken from different sources and are adjusted from the original for the sole purpose to improve clarity of the Report. Modifications to images used in this Report are limited to cropping, magnification, file compression, or enhancement of color, brightness, contrast or insertion of text boxes, arrows or lines.

Abbreviations

AAIS	The Air Accident Investigation Sector of the United Arab Emirates
AAL	Above airfield level
AOC	Air operator certificate
AP	Autopilot
ARC	Airworthiness review certificate
ATC	Air traffic control
APU	Auxiliary power unit
AUTO	Automatic
°C	Degrees Celsius
CAR	*Civil Aviation Regulations* of the United Arab Emirates
CAT	Category
CB	Cumulonimbus
CSQ	Etihad Corporate Safety and Quality
CVR	Cockpit voice recorder
DFDR	Digital flight data recorder
DME	Distance measuring equipment
EBT	Evidence-based training
ECAM	Electronic centralized aircraft monitoring
FCOM	*Flight Crew Operating Manual*
FCTM	*Flight Crew Techniques Manual*
FDR	Flight data recorder
FL	Flight level
FOD	Foreign object debris
fpm	feet per minute
ft	Feet
GCAA	The General Civil Aviation Authority of the United Arab Emirates
G/S	Glideslope
ICAO	International Civil Aviation Organization
IF	Intermediate fix
ILS	Instrument landing system
IMC	Instrument meteorological conditions
IMT	Incident management team
IR	Instrument rating
KT	Knots
LAND	Landing

LO	Low
LOC	Localizer
m	Meter
mbar	millibar
MAX	Maximum
MED	Medium
MEL	*Minimum equipment list*
MHz	Megahertz
MPA	Multi-pilot aircraft
MPL	Multi-crew pilot license
No.	Number
OCC	Operator conversion course
OM	*Operations manual*
OPC	Operator proficiency check
OPS	Operations
PAPI	Precision approach path indicator
PDM	Pilot duty manager
PF	Pilot flying
PFR	Post flight report
PM	Pilot monitoring
PRESS	Pressure
REV	Reverse
SEP	*Safety and emergency procedures*
SOP	Standard operating procedure
STD	Standard time of departure
SPS	Samn-Perelli scale
STC	Standard transition course
UAE	The United Arab Emirates
UTC	Coordinated Universal Time
VP	Vice president
Z	Zulu

Synopsis

On 20 June 2019, an Etihad Airways, Airbus A320-232, registration A6-EIT, operated a scheduled passenger flight EY250, from Abu Dhabi International Airport, the United Arab Emirates, to Calicut International Airport, India. There were 124 persons onboard, comprising 116 passengers, two flight crewmembers, and six cabin crewmembers.

During the ILS approach to runway 28, the flight crew initiated a go-around due to heavy rain over the runway as reported by air traffic control (ATC). Approximately 16 minutes later, the flight crew initiated a second instrument landing system (ILS) approach to runway 28. On landing, the Aircraft touched down to the right of the runway centerline, and the right main landing gear then struck five runway edge lights. The Commander was able to steer the Aircraft to the centerline and continue the landing roll uneventfully.

The Air Accident Investigation Sector of the United Arab Emirates (AAIS) determines that the cause of the Incident was that after crossing the threshold, the Aircraft drifted towards the right side of the runway due to a slight but continuous roll input to the right. The Aircraft touched down almost at the runway edge line, and this was followed by an increase in lateral deviation towards the runway edge due to the application of an ineffective flight control recovery technique. The Aircraft then struck and damaged five runway edge lights as the right main landing gear entered the runway shoulder.

The AAIS identifies the following contributing factors to the Incident: the lack of runway centerline lighting; the presence of a moderate intensity rain shower over the runway affected visibility after the Aircraft crossed the threshold, which resulted in a loss of visual references; the pilot flying situational awareness was adversely affected by his expectation that the Aircraft would remain aligned with the centerline until touchdown, since it was aligned when crossing the threshold; the unintentional roll inputs to the right applied due to a subconscious action; control inputs to re-align the Aircraft were not affirmative in that only incremental left rudder inputs were made without an associated left roll before touchdown; the recovery action to take the Aircraft back to the centerline by applying right rudder input after touchdown was relatively late due to the high workload; and despite the Co-pilot awareness of the deviation to the right of the runway centerline, he, as the pilot monitoring, did not intervene to attract the attention of the Commander.

The AAIS issued six safety recommendations: five to the Etihad Airways, and one to Calicut Airport Authority.

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1. Factual Information

1.1 History of the Flight

On 20 June 2019, an Etihad Airways, Airbus A320-232, registration A6-EIT, operated a scheduled passenger flight EY250, from Abu Dhabi International Airport (OMAA[1]), the United Arab Emirates, to Calicut International Airport (VOCL[2]), India. There were 124 persons onboard, comprising 116 passengers, two flight crewmembers, and six cabin crewmembers.

The Aircraft was pushed back from parking stand 410 at about 1916 UTC. The Commander was the pilot flying (PF) and the Co-pilot was the pilot monitoring (PM).

The Aircraft took off from runway 31L at 1934, and followed a standard instrument departure via KANIP 4K[3].

After takeoff and climb, the Aircraft cruised at flight level (FL) 350 and the flight proceeded normally.

At 2242, the Aircraft commenced its descent for an instrument landing system (ILS) approach to runway 28 of VOCL.

At 2317:50, when the Aircraft was on final approach, almost over the runway threshold, at 200 feet above airfield level (AAL), the flight crew initiated a go-around. Air traffic control (ATC) had reported heavy rain over the runway and the Commander decided to carry out a go-around due to the risk that the Aircraft could be affected by hydroplaning[4] after touchdown.

Approximately 16 minutes later, the flight crew initiated a second ILS approach to runway 28.

Figure 1. Flight path on landing at runway 28 of Calicut International Airport (VOCL)

On landing at 2339:00, the Aircraft touched down to the right of the runway centerline, and the right main landing gear then struck five runway edge lights. The Commander was able to steer the Aircraft to the centerline and continue the landing roll (figure 1). A message indicating tire low pressure appeared on the electronic centralized aircraft monitoring (ECAM).

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1 OMAA is the ICAO four letter airport code for Abu Dhabi International Airport

2 VOCL is the ICAO four letter airport code for Calicut International Airport

3 EKANIP 4K is one of OMAA standard instrument departure routings from runway 31L

4 Hydroplaning is a condition in which standing water, slush or snow, causes the moving wheel of an aircraft to lose contact with the load bearing surface on which it is rolling with the result that braking action on the wheel is not effective in reducing the ground speed of the aircraft

After vacating the runway, the flight crew stopped the Aircraft in order to assess the situation. The Aircraft then continued taxiing to parking stand 5. The engines were shut down at 2347:21.

1.2 Injuries to Persons

There were no injuries to persons because of the Incident.

Table 1. Injuries to persons

Injuries	Flight crew	Cabin crew	Passengers	Total on board	Others
Fatal	0	0	0	0	0
Serious	0	0	0	0	0
Minor	0	0	0	0	0
None	2	6	116	124	0
TOTAL	**2**	**6**	**116**	**124**	**0**

1.3 Damage to Aircraft

After landing in Calicut and shutting down the engines, the flight crew requested the Aircraft maintenance engineers to carry out an assessment of the landing gear. After the assessment, the engineers advised that the right main landing gear inboard wheel tire was damaged (figure 2) and the outboard tire was worn beyond limits with some tread separation (figure 3).

Figure 2. Right main landing gear - inboard wheel tire

Figure 3. Right main landing gear - outboard wheel tire

1.4 Other Damage

Five runway 28 edge lights were damaged (figure 4).

Figure 4. Three of the five damaged runway edge lights

1.5 Personnel Information

The qualifications and experience of the Commander and Co-pilot were as shown in table 2.

Table 2. Flight crewmember data

	Commander	Co-pilot
Age	53	27
Type of license	ATPL-A[5]	MPL[6]
Valid to	25 June 2022	26 July 2024
Rating	IR/MPA[7], A320	IR/MPA, A320
Total flying time (hours)	15,179.73	1,670.57
Total Command time on all types (hours)	10,442.32	15.2
Total time on this type	12,943.33	1,510.77
Total Command time on this type (hours)	8,876.98	0
Total twelve months (hours)	350.55	453.38
Total on type the last 28 days	45.1	40.7
Total on type the last 14 days	26.6	17.9
Total last 7 days (hours)	18.72	17.9
Total on type last 7 days (hours)	18.72	17.9
Total last 24 hours (hours)	4.43	4.43
Last recurrent SEP[8] training	17 June 2019	2 August 2018
Last proficiency check	13 February 2019	2 February 2019
Last line check	17 April 2019	9 October 2018
Medical class	Class 1	Class 1
Valid to	6 October 2019	21 August 2019
Medical limitation	VNL[9]	Nil
English language proficiency (ELP)	Level 6	Level 4

5 ATPL-A: Airline transport pilot license - Aeroplane

6 MPL: Multi-crew pilot license

7 IR/MPA: Instrument rating/multi-pilot aircraft

8 *SEP: Safety and emergency procedures*

9 VNL is a medical limitation code of correction for defective near vision, which means that the license holder should have readily available spectacles that correct for defective near vision as examined and approved by the aero-medical center or aero-medical examiners

Based on the records provided to the Investigation, the flight crews' qualifications and experience were not factors in the Incident.

The flight crew pilot licenses and medical certificates were valid at the time of the occurrence.

The flight crew roster and rest period indicated that they all met the requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

The Commander had flight duties for two days before the day of the Incident flight. He stated that he was sufficiently rested prior to conducting the Incident flight and that he was fit to operate the flight.

Two days before the day of the Incident flight, the Co-pilot was off duty for one day. He had been on duty during the day before the day of the Incident flight. He was well-rested prior to conducting the Incident flight and he stated that he was fit to operate the flight.

1.6 Aircraft Information

1.6.1 Aircraft data

Table 3 illustrates general information related to the Aircraft.

Table 3. Aircraft data

Manufacturer:	Airbus
Model:	A320-232
Manufacturer serial number:	5791
Nationality and registration mark:	United Arab Emirates, A6-EIT
Name of the Operator:	Etihad Airways
Certificate of airworthiness	
Number:	UAE-COA-0177
Original issue date:	17 October 2013
Re-issue date:	4 October 2018
Valid to:	*Airworthiness Review Certificate ARC-EY-EIT-6* 16 October 2019
Certificate of registration	
Number:	UAE-COR-0588
Original issue date:	17 October 2013
Date of production/delivery:	17 October 2013
Time since new (flight hours):	27,112.48
Cycles since new:	8,339
Last major inspection, type, date and hours/cycle:	24 May 2019 (28A-Check), 26,774.05 hours, 8,224 cycles
Time since last major inspection (flight hours):	1,322
Cycles since last major inspection:	439
Maximum take-off weight:	77,000 kg
Maximum landing weight:	66,000 kg
Maximum zero fuel weight:	62,500 Kg

1.6.2 Engine data

Table 4 illustrates general information related to the engines on the date of the Incident.

Table 4. Engine data

Manufacturer:	International Aero Engine	
	No. 1 engine	No. 2 engine
Model:	IAE V2527-A5	IAE V2527-A5
Serial number:	V13034	V16195
Date installed on Aircraft:	18 October 2017	14 April 2016
Time since new (hours):	38,441	27,489
Cycles since new:	16,500	9,384
Time since last overhaul/inspection (hours):	7,506	14,719
Cycles since last overhaul/inspection:	2,367	4,537

1.6.3 Maintenance records

Examination of the Aircraft maintenance records showed that no technical defects had been logged prior to the flight. There were no *minimum equipment list (MEL)* category A, B or C items recorded.

1.7 Meteorological Information

Table 5 shows the METAR for Calicut International Airport on 20 and 21 June 2019, over the period from 2300 to 2400 UTC.

Table 5. METAR, 20 and 21 June 2019, 2300 to 2400 UTC
METAR VOCL 202300Z 24006KT 4000 -RA FEW006 SCT012 BKN080 26/23 Q1007 TEMPO 3000 RA
METAR VOCL 202330Z 29006KT 2000 RA SCT003 SCT012 OVC080 24/22 Q1007 TEMPO 1500 RA
METAR VOCL 210000Z 36003KT 2000 -RA SCT004 SCT012 OVC080 24/23 Q1007 BECMG 3000 -RA

Table 6 describes the above METAR.

Table 6. Description of the METAR			
	20 June 2330 UTC	**20 June 2330 UTC**	21 June 0000 UTC
Wind	Direction: 240 degrees/speed: 6 knots	Direction: 290 degrees/speed: 6 knots	Direction: 360 degrees/speed: 3 knots
Visibility; weather	4,000 m; light rain	2,000 m; rain	2,000 m; light rain
Clouds	Few (1-2 oktas) cloud at 600 ft; Scattered (3-4 oktas) cloud at 1,200 ft; Broken (5-7 oktas) cloud at 8,000 ft	Scattered cloud at 300 ft, and at 1,200 ft; Overcast (8 oktas) cloud layer at 8,000 ft;	Scattered cloud at 400 ft, and at 1,200 ft; Overcast cloud layer at 8,000 ft
OAT	26°C	24°C	24°C

Dew point	23°C	22°C	23°C
Pressure (Altimeter)	1007 mbar	1007 mbar	1007 mbar
Condition	Temporarily change with visibility of 3,000 m and rain	Temporarily change with visibility of 1,500 m and rain	Visibility becoming 3,000 m and light rain

The dispatch documents provided to the flight crew included a fixed time prognostic chart of the area of the route from OMAA to VOCL valid for 00:00 UTC, 21 June 2019 from FL100 to FL450, as shown in figure 5. The weather information of figure 5 was as forecast about twenty minutes after the time at which the Incident occurred. In the area, there were isolated embedded cumulonimbus clouds from FL100 to FL450. Compared to the fixed time prognostic chart for the same section of the route from OMAA to VOCL valid for six hour period before, the embedded isolated cumulonimbus (CB) was not very different to the forecast issued for 00:00 UTC, 21 June 2019.

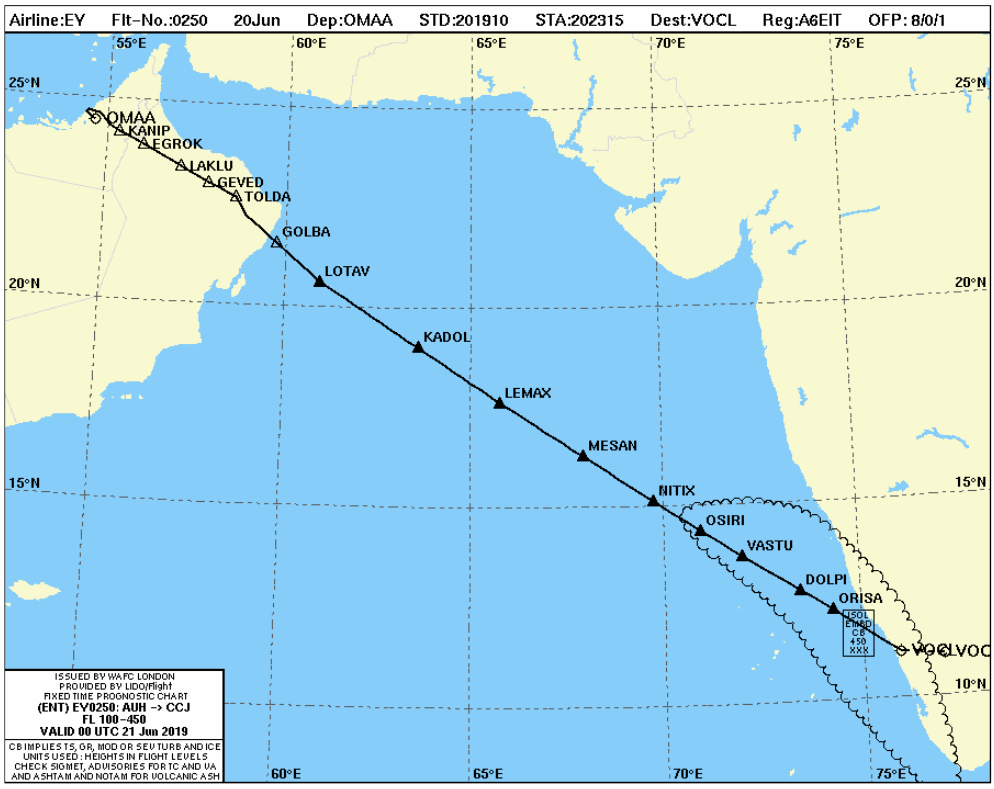


Figure 5. Fixed time prognostic chart of EY250 enroute from OMDB to VOCL, valid for 00:00 UTC, 21 June 2019 from FL100 to FL450

The Incident occurred on 20 June 2019 at 2339 UTC, 0509 on the following day in Calicut local time (UTC+5:30). It was dark when the Incident occurred. Sunrise at Calicut was at 0603 local time.

1.8 Aids to Navigation

Fluctuations in the ILS signal, for both the localizer and glideslope, occurred during both approaches. The ILS signal fluctuations are analysed in Part 2 of this Final Report.

There were no problems related to on-board navigation aids, or their serviceability during the Incident.

1.9 Communications

All communications between the flight crew and Calicut Tower on 123.35 MHz, and Approach on 122.95 MHz, were clear and normal.

1.10 Aerodrome Information

Calicut International Airport, ICAO code VOCL, is located in Karipur, India, about 15 nautical miles (28 kilometers), southeast of Kozhikode (also known as Calicut) and 13.5 nautical miles (25 kilometers) northwest of Malappuram. The Airport elevation is 326 feet above mean sea level.

The Airport is located on a hilltop with terrain on both sides and a sharp drop of approximately 150 feet down to the valley floor. The surrounding terrain is lighted to aid in arrival and approach with visual cues to assist situational awareness. High terrain, rising to over 9,000 feet, is located to the north and east of the Airport.

The Airport was equipped with a concrete runway 10/28, 2,860 meters long with an orientation of 283° magnetic. The runway was 45 meters wide, or 60 meters including the shoulders. The aerodrome elevation was 342 feet, while the elevation of runway 28 was 326 feet.

The runway was equipped with an ILS and simple touchdown zone lighting that consisted of a pair of lights located on each side of the runway centerline. The approach chart for ILS 28 Z (figure A2.1 in Appendix 2) indicated that the runway was equipped with an ILS with a glideslope of 3.2 degrees. Minima (decision altitude) was 541 feet.

Runway 28 was equipped with a non-standard approach light system, threshold identification lights, and non-standard runway edge lights. There were no centerline lights.

1.11 Flight Recorders

The Aircraft was equipped with a digital flight data recorder (DFDR) and cockpit voice recorder (CVR) as noted in table 7.

Table 7. Flight recorders

	Type	Part number	Serial number
CVR	**L3**	2100-1026-02	314345
DFDR	**L3**	2100-4045-00	650668

Data from the DFDR and CVR were successfully downloaded. Data from the DFDR was successfully analyzed. However, the downloaded CVR data did not contain information related to the Incident flight. The Incident CVR data had been overwritten by data recorded during the preparation of the subsequent flight.

ATC transcript was provided to the Investigation. The DFDR data and ATC transcript were examined, and prior to the examination, the timelines of the DFDR and ATC data were synchronized.

1.12 Wreckage and Impact Information

The Aircraft was intact.

1.13 Medical and Pathological Information

Post-incident blood tests were requested to determine if any psychoactive materials could have degraded the flight crew's performance. The blood test results were negative for both flight crewmembers.

1.14 Fire

There was no sign of fire.

1.15 Survival Aspects

None of the persons onboard sustained any injury. The passengers and crew disembarked normally at Calicut International Airport.

1.16 Tests and Research

In the frame of the Aircraft recovery/repair activities, the Aircraft manufacturer, Airbus, produced a report. No other tests or research were required to be conducted as a result of the Incident.

1.17 Organizational and Management Information

1.17.1 General information

The Operator commenced operations in November 2003 operating in compliance with an air operator certificate (AOC) issued by the General Civil Aviation Authority of the United Arab Emirates.

1.17.2 Training

Both pilots had completed all required training as per the Operator's requirements specified in *Part D* of the *Operations Manual (OM-D)*.

Adverse weather (every module), and adverse wind (annual) training were required to be provided as part of evidence-based training (EBT) which refers to the recurrent simulator training and checking, including the licence and Operator proficiency checks (OPC).

Adverse flight condition training (under special operations training), which includes contaminated runway operations, was required to be provided as one of the modules in the initial flight crew ground training required for the Operator conversion course (OCC) and standard transition course (STC).

Runway excursion risk management, including contaminated runway operations, was required to be provided under recurrent special programs training.

Selection of aerodromes and operating minimums review was required to be provided under recurrent general operations training, at least annually, which included evaluation of the following knowledge:

- Approaches authorised by the GCAA;
- Ceiling and visibility requirements for takeoff, approach and landing;
- Allowance for inoperative ground components; and
- Wind limitations (crosswind, headwind and tailwind).

The training and checking of the EY250 pilots conducted during flight simulator training sessions was completed to the expected level of proficiency, according to the prescribed syllabus.

The simulator sessions and conversion courses included training, checking and

evaluation to ensure knowledge of wind limitations (crosswind, headwind and tailwind).

Based on his most recent training evaluation carried out on 14 February 2019, the Commander was rated as competent in the overall assessment with the following performance grades:

- *Adequate* in applying procedures, communication, managing the automation, controlling the aircraft, having knowledge, leading and working as a team member, solving problems and making decision, situational awareness, and managing the workload, by regularly demonstrating most of the performance indicators when required, which resulted in a safe operation.

According to his most recent training evaluation carried out on 3 February 2019, the Co-pilot was rated as competent in the overall assessment with the following performance grades:

- *Adequate* in applying procedures, communication, managing the automation, controlling the aircraft, having adequate knowledge, leading and working as a team member, solving problems and making decisions, situation awareness, and managing the workload, by regularly demonstrating most of the performance indicators when required, which resulted in a safe operation.
- *Effective* in controlling the aircraft, and situational awareness, by regularly demonstrating all of the performance indicators when required, which enhanced safety.

1.17.3 Standard operating procedures

The *Approach and Landing Techniques* section in the *Flight Crew Techniques Manual (FCTM)*, stated that: “If a normal touchdown distance is not possible, a go-around should be performed.”

The *Considerations About Go-around* section in the *FCTM* in terms of decision making, stated that:

> “The flight crew must consider to perform a go-around if:
>
> - There is a loss or a doubt about situation awareness, or
> - The approach is unstable in speed, altitude, or flight path in such a way that stability is not obtained by 1,000 ft AAL, or is not maintained until landing.”

The SOP of *Trajectory Stabilization* in the *Final Approach* section in the *FCTM*, stated that: “If, for any reason, one flight parameter deviates from stabilized conditions, the PM will make a callout.”

The SOP for final approach using LOC G/S guidance in the *Flight Crew Operating Manual (FCOM)*, stated that:

> “…
>
> **FOR CAT I, CAT II, CAT III WITH DH APPROACH**
>
> AT ENTERED MINIMUM +100 ft
>
> ONE HUNDRED ABOVE.....MONITOR OR ANNOUNCE
>
> AT ENTERED MINIMUM
>
> MINIMUM.....MONITOR OR ANNOUNCE
>
> Below minimum, the visual references must be the primary reference until landing.
>
> **If visual references are sufficient:**
>
> CONTINUE.....ANNOUNCE

AP.....AS RQRD

- **If visual references are not sufficient:**

GO AROUND.....ANNOUNCE

Initiate a go around."

1.17.4 Airport categories

The VOCL airport is a Category B aerodrome as specified in the Operator's *Route Information Manual – Destination Airport Categories*.

As per the manual, the definitions of the aerodrome categories are set out below:

"Category A – Aerodromes satisfy all of the following requirements:

- An approved instrument approach procedure
- At least one runway with no performance limited procedure for take-off and/or landing
- Published circling minima not higher than 1000ft AAL
- Night operations capability

Category B – Aerodromes do not satisfy the Category A requirements or require extra considerations such as:

- Non-standard approach aids and / or approach patterns
- Unusual local weather conditions
- Unusual characteristics or performance limitations
- Any other relevant considerations including obstructions, physical layout, lighting etc. "

No Operator restriction applied at VOCL and either a Commander or a Co-pilot could perform the landing, as per the manual.

1.17.5 Airport briefs

The VOCL airport briefs are specified in the Operator's *Route Information Manual – Airport Briefs*, some of which are given below.

Regarding the weather, Calicut generally has fine weather from October to May. During the Monsoon season (June to September), the airport is subjected to heavy rain and gusting winds. During the winter, fog is common. During clear nights, clouds may settle in the valley below the runway thresholds, as the sun rises, the fog lifts and can impair visibility.

On arrival at VOCL, in all cases, pilots must aim to touchdown within the touchdown zone, or a go-around must be initiated.

Special consideration of VOCL is included as following:

"✈ Caution: Due to fluctuating ILS Glideslope performance, it is recommended to first arm and capture LOC when established on a final intercept heading (and not before). Thereafter ensure correct sensing of the G/S indications prior to selection of APP mode.

✈ Both RWYs have poor visual cues at night. RWY 28 has a distinct upslope.

✈ Standing water on the RWY during periods of heavy rain."

During the first approach, the APP mode was engaged after the localizer was established, however, it was prior to the correct sensing of the glideslope indications.

During the second approach, The APP mode was activated prior to the Aircraft becoming established on the localizer, but the localizer had already been captured. This activation was prior to the sensing of the glideslope indications.

1.17.6 *OM–A* for flight recorder preservation

The *OM-A* contained the following procedures regarding flight recorder preservation:

> "**1.4.1 Authority, Duties and Responsibility of the Commander**
>
> The commander shall:
>
> …
>
> 13. Not permit:
>
> - …;
> - A cockpit voice recorder to be disabled or switched off during flight unless he believes that the recorded data, which otherwise would be erased automatically, should be preserved for incident or accident investigation, nor permit recorded data to be manually erased during or after flight in the event of an accident or an incident subject to mandatory reporting."

, and

> "**2.1.3.12.1 Cockpit Voice Recorder (CVR)**
>
> Cockpit voice recorder recordings may not be used for purposes other than for the investigation of an accident or incident subject to mandatory reporting except with the consent of all crew members concerned.
>
> **Note**: It is prohibited to intentionally erase the CVR and/or FDR data. It is also prohibited to manually switch off the CVR and/or FDR unless doing so is essential to preserve data relating to an accident or incident that would otherwise be lost."

1.17.7 Safety management system

The Etihad Corporate Safety and Quality (CSQ) Department was responsible for planning, organizing, directing and controlling the Safety and Quality Management System.

A basic safety risk assessment process was in place for analysis and implementation of risk controls before introduction of a new route into its operations. This process, called *Airport Clearance Assessment*, was carried out prior to commencement of operations to Calicut airport in 2009. Following the Incident, the same process, with more detailed assessments, was carried out.

The Operator, under the Flight Safety Action Group, carries out hazard identification and risk analysis, primarily driven by investigations of its safety events. Safety assurance processes are employed for autonomous monitoring of the effectiveness of safety risk controls and corrective actions implemented across different operations departments.

Following the Incident, the Operator highlighted its concern to Calicut Airport Authority regarding the airport infrastructure limitations, which were identified as contributory to the Incident based on Operator's internal review.

1.18 Additional Information

1.18.1 National standards for flight recorder preservation

The *Civil Aviation Regulations* (*CAR*) part IV – *Operations Regulations*, *CAR-OPS 1 – Commercial & Private Air Transportation (Aeroplanes)*, prescribes the requirements for the operations of aeroplanes as commercial and private air transportation. The requirements for preserving flight recorders as per *CAR-OPS1*, stated that:

> "**CAR-OPS-1 1.085 Crew Responsibilities**
>
> (f) The commander shall:

…

(10) Not permit:

…

(ii) A cockpit voice recorder to be disabled or switched off during flight unless he believes that the recorded data, which otherwise would be erased automatically, should be preserved for incident or accident investigation nor permit recorded data to be manually erased during or after flight in the event of an accident or an incident subject to mandatory reporting."

1.19 Useful or Effective Investigation Techniques

This Investigation was conducted in accordance with *Air Accident and Incident Investigation Regulations* of the United Arab Emirates, and the AAIS approved policies and procedures, and in conformity with the Standards and Recommended Practices of *Annex 13* to the Convention on International Civil Aviation.

2. Analysis

2.1 General

The Investigation gathered data from various sources for the purpose of determining the causes and contributing factors that led to the Incident.

This analysis covers the pilot flying (PF) technique, the airfield and weather conditions, related Operator's procedures, flight operations and preservation of CVR data.

This part of the Report explains the contribution of the relevant aspects to the Incident. The analysis also contains safety concerns that may not have been contributory to the Incident but are significant in adversely affecting safety.

2.2 The First Approach and Go-around

The flight crew briefed for the approach before reaching the top of descent. The Aircraft started to descend from flight level (FL) 350 at 2242:27. EY250 then proceeded for an ILS approach to runway 28 VOCL, as shown in figure 6.

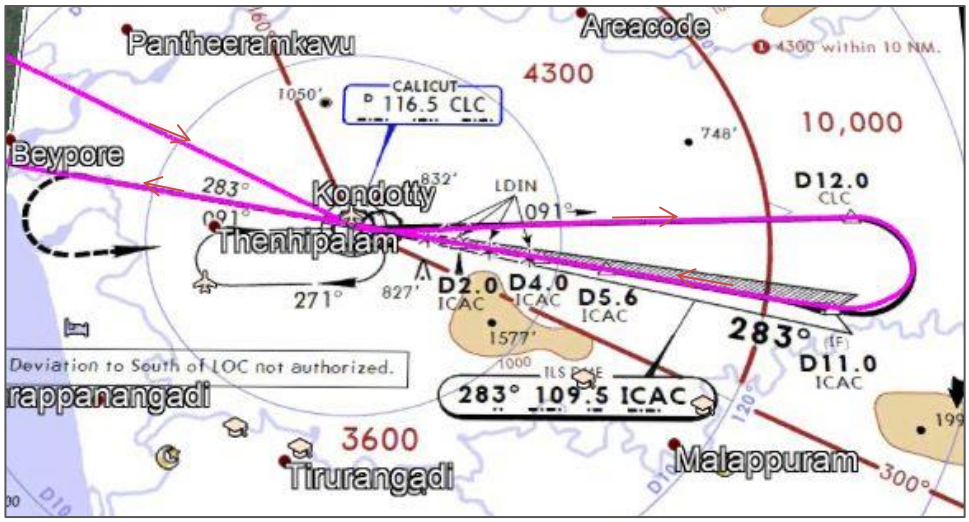


Figure 6. First approach flight path of EY250 on the Calicut ILS Z runway 28 approach chart

When approaching CLC during the initial approach to Runway 28, the Tower Controller informed EY250 of light rain over the runway. The Commander stated that the weather radar showed a red echo at two to three nautical miles representing rain cells, which the Aircraft flew through. However, when the Aircraft was almost overhead CLC, he could see that there were no cumulonimbus (CB) clouds over the runway. He considered that it was acceptable to continue the approach for instrument landing system (ILS) Z Runway 28.

As the Aircraft flew over CLC, while descending through 4,960 feet pressure altitude, the flight crew informed the Tower Controller that EY250 was leaving CLC. The Tower Controller then instructed EY250 to descend as per the approach procedure, and requested EY250 to report when established on the ILS Z runway 28 localizer. The Controller mentioned the presence of moderate rain over the field and that the runway surface condition was wet.

Prior to turning right when the Aircraft was flying outbound from CLC as per the approach chart, the Tower Controller informed EY250 that the visibility was 3,000 meters in rain. Approximately 20 seconds later, the flight crew requested wind information and the Controller informed them that the wind direction was 270 degrees and the speed was 10 knots. The Controller also informed EY250 that there was now heavy rain over the airfield.

The Aircraft performed a right turn as per the approach chart, and after passing the IF point, the localizer track mode engaged when the Aircraft was at approximately 10.8 nautical miles DME.

Three seconds after the localizer track mode established, the APPR pushbutton (p/b) was pressed that engaged the approach (APP) mode. The Aircraft was flying level in altitude hold mode (ALT) at a selected altitude of 3,100 feet.

The glideslope capture mode engaged and altitude hold mode disengaged when the Aircraft was at approximately 8.9 nautical miles DME. The glideslope track mode engaged when the Aircraft was at 8.4 nautical miles DME while descending through 2,980 feet pressure altitude.

It revealed that the APP mode was engaged after the localizer was established, however, it was prior to the correct sensing of the glideslope indications. This was not in accordance with the recommendation of when to select the APP mode", as given as *Caution* in the *Route Information Manual* (see Sub-section 1.17.5), however, this non-conformity did not affect the further approach.

When the Aircraft was at approximately 5.7 nautical miles DME, while descending through 2,160 feet pressure altitude, the flight crew requested the wind information, to which the Tower Controller replied that the wind direction was 280 degrees and the speed was 9 knots.

When the Aircraft was at approximately 3.6 nautical miles DME, while descending through 1,470 feet pressure altitude, the flight crew requested the runway visibility conditions, which the Tower Controller replied was 3,000 meters. A QNH setting was then requested by the flight crew, which the Controller provided as 1007 mbar.

Due to the most recent report of heavy rain over the runway, the Commander stated that he considered the possibility of flying a go-around. This consideration was based on the risk of hydroplaning after touchdown. However, he waited until the Aircraft reached minima (decision altitude) of 541 feet, to make the go-around decision. He wished to see whether there was any weather development, especially in relation to the heavy rain. The Commander did not mention the possibility of performing a go-around to the Co-pilot during the final approach.

At 1,000 feet above the airfield level altitude (AAL), the Aircraft was configured in a full flap configuration (slats/flaps 27/40 degrees), landing gear down, ground spoilers armed, and autobrake medium (MED) mode armed. Both autopilots and flight directors were engaged in localizer track (lateral) and glideslope track (vertical) modes, and the autothrust was engaged and active.

During the approach from 1,000 feet to 80 feet AAL, the autothrust was active in SPEED mode. The lowest selectable airspeed (VLS) was 135 knots. The speed target was managed and varied between 140 and 146 knots. The airspeed varied between 139 and 149 knots. The vertical load factor varied between +0.9 and +1.13G as the Aircraft was descending between 305 feet (at 2317:40) and 280 feet AAL (at 2317:44).

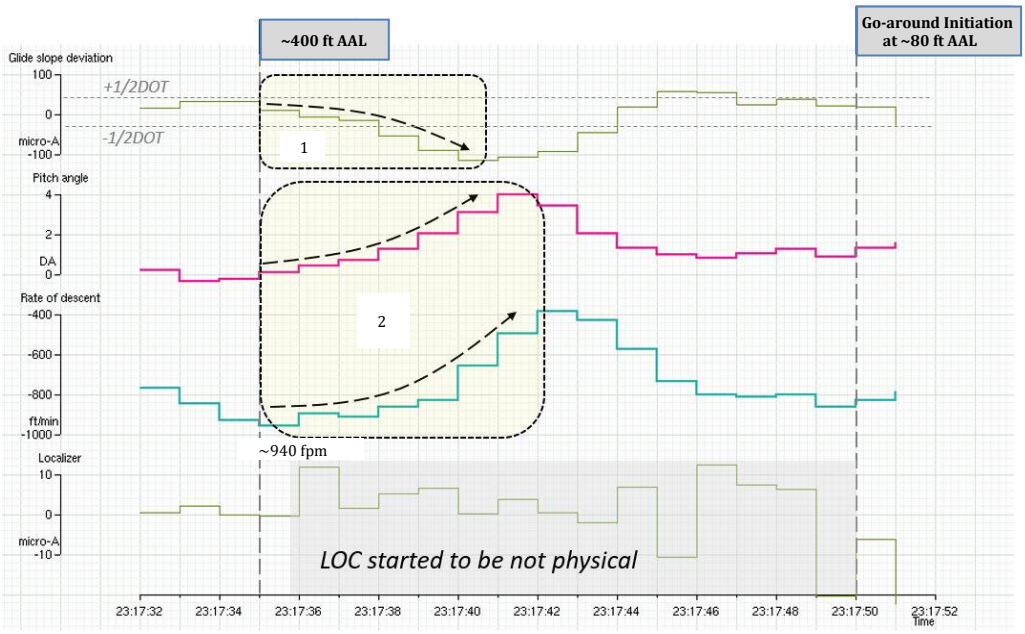
The most recent wind information reported by ATC was 280 degrees with a speed of 9 knots, when the Aircraft was on the glideslope at 5.6 nautical miles DME. Visibility of 3,000 meters had been advised by ATC as the Aircraft was descending through 1,420 feet pressure altitude at 3.4 nautical miles DME.

The Commander stated that he first observed the runway when the Aircraft was less than two nautical miles from the threshold and before reaching minima. Due to the heavy rain reported and his observation of rain over the runway, he decided not to land the Aircraft because he thought that a hydroplaning risk existed and therefore it was unsafe to land. Referring to the Operator's *Route Information Manual – Airport Briefs*, particularly for Calicut,

special consideration is included regarding a condition of standing water on the runway during periods of heavy rain.

The Commander stated that he asked the Co-pilot “shall we do the go-around” in order to prepare the Co-pilot. When the Aircraft reached minima, the Commander decided to perform the go-around and simultaneously called out “go-around”. A normal go-around was flown as per the standard operating procedure (SOP).

As the Aircraft descended between 400 feet and 305 feet AAL, the glideslope deviation was on the glide path and started to move to 1.5 dot below the glide path (profile) within 5-6 seconds, as shown in figure 7. The 1.5 dot deviation should have represented an increment of an absolute value of the vertical speed of approximately 1,000 feet per minute, which did not occur. The rate of descent was approximately 940 feet per minute and decreased to 380 feet per minute during this period.



Note:

1. Glide slope deviation started to decrease to 1.5 dot within 5-6 seconds below profile
2. APs ordered a pitch-up dynamic leading an increment of pitch angle and a decrement of ROD

Figure 7. Glideslope and localizer behavior during first approach

Within this period, the deviation below the glide did not match the Aircraft’s physical movement. The glideslope deviation increasingly moved below the profile, which should have represented an increase in the rate of descent. This was not the case, and instead the Aircraft rate of descent decreased.

Anomalies were recorded in the following flight parameters. Firstly, the vertical acceleration was near to zero during the four seconds (2317:34 – 2317:38) prior to the increase in vertical acceleration. Secondly, the Aircraft rate of descent (absolute value of vertical speed) was decreasing, which was in accordance with the increase in the vertical acceleration.

In order to counteract the glide deviation below the profile, the autopilots ordered a pitch-up dynamic that led in an increase in pitch angle and a decrease in the rate of descent. During this period, no significant atmospheric perturbations were observed.

Due to the deviations described above, the Investigation suspected perturbation of the available glide slope signal.

During the period between 2317:36 and 2317:50, when the Aircraft was below 400 feet AAL, the localizer deviation varied between 1/4 dot to the right and 1/3 dot to the left of the localizer with a high frequency. This condition was also suspected to be a consequence of a perturbation of the localizer signal.

Referring to the Operator's *Route Information Manual – Airport Briefs*, particularly for Calicut, fluctuation of the glideslope is a known issue. A *Caution* of recommendation of when to select the APP mode, as provided in the manual, was not followed by the flight crew. However, the Investigation does not believe that the flight crew action in not following the mentioned *Caution* was related to the fluctuation of the ILS signal below 400 feet AAL, since there was no evidence of ILS signal fluctuation above 400 feet AAL for either localizer or glideslope.

The Commander stated that he made the decision to fly the go-around based on his perception of the risk of hydroplaning on the runway due to the presence of heavy rain. He was aware of the glideslope fluctuation issue. He was able to see the runway from an approximate distance of two nautical miles, therefore, he used the precision approach path indicator (PAPI) lights as a reference to determine the Aircraft vertical position.

2.3 The Second Approach and Landing

After performing the go-around, instead of following the approach chart of ILS Z Runway 28 for another approach, the flight crew requested an extension of the Aircraft track on the 280 degrees heading until the Aircraft was over the sea due to better weather conditions in that area. The crew planned to wait for the weather over the runway to improve.

When the Aircraft was approximately eight nautical miles outbound from CLC, the flight crew requested a heading of 320 degrees with the intention of preparing for another approach within 10 minutes. The Tower Controller then informed the flight crew that the intensity of the rain had reduced and visibility had improved. The flight crew acknowledged this information and informed the Controller that they would advise their intentions.

Prior to deciding to fly another approach, the flight crew asked the Controller whether heavy rain was still present over the runway. The Tower Controller informed the flight crew that light rain was falling and visibility was 3,000 meters. Based on the Tower Controllers' information, the flight crew decided to conduct a second approach since they considered that the intensity of the rain had lessened. However, the visibility remained the same.

Approximately a further 11 minutes after the go-around, EY250 commenced a second ILS approach to runway 28, as shown in figure 8. The flight crew reported to the Tower Controller as EY250 passed CLC while flying level at 3,600 feet pressure altitude above the runway. The Tower Controller requested the flight crew to report when the Aircraft was established on the localizer.

As the Aircraft was turning towards the IF flying inbound to CLC, the localizer capture mode engaged and the flight reported "ETD25B Localizer Runway 28". The Controller then informed EY250 that there was light rain over the airfield, the runway surface condition was wet, and the wind was from 240 degrees at a speed of 4 knots. The Controller cleared EY250 to land on runway 28 and the flight crew read back the clearance correctly.

When the Aircraft had almost passed the IF, approximately 11.1 nautical miles DME, the Tower Controller informed EY250 that the visibility was now 2,000 meters.

As the Aircraft was passing the IF, in a straight and level condition just after turning to the right, the APP mode was engaged. The Aircraft was in an altitude hold mode (ALT) at a selected altitude of 3,100 feet, and the localizer was captured.

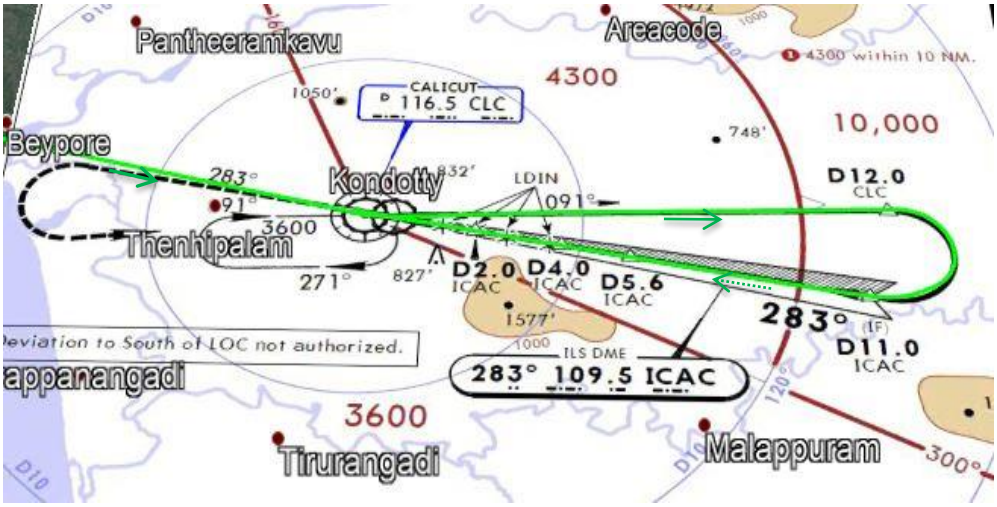


Figure 8. EY250 second approach flight path on approach chart of Calicut ILS Z runway 28

The APP mode was activated prior to the Aircraft establishing on the localizer, but the localizer had already been captured. This activation was prior to the sensing of the glideslope indications, which was not in accordance with the *Caution* as recommended in the *Route Information Manual*. However, this non-conformity did not affect the approach.

When the Aircraft was at approximately four nautical miles DME while descending through 1,610 feet pressure altitude on the glideslope, the flight crew requested the wind condition. The Controller informed the crew that the wind was from 220 degrees at a speed of 5 knots.

At 1,000 feet above the airfield level altitude (AAL), the stabilization height recommended in IMC by the *FCTM and OM Part A*, the Aircraft was already configured with full flap (slats/flaps 27/40 degrees), landing gear down, ground spoilers armed and autobrake armed in 'MED' mode. Both autopilots and flight directors were engaged in localizer and glideslope track modes, and the Aircraft was on the correct lateral and vertical flight path in landing configuration. Autothrust was engaged and active in "SPEED" mode, which means that the thrust was stabilized and the Aircraft was at the target speed for the approach. No excessive flight parameter deviations occurred. Therefore, the final approach of EY250 was stabilized at 1,000 feet AAL in accordance with the *FCOM* for "Stabilization Criteria" and the flight parameter deviations to be called out as per the *FCOM* for "Flight Parameters".

As the Aircraft was descending between 1,000 and 730 feet AAL, the target speed was managed and varied between 138 and 139 knots. The indicated airspeed varied between 138 and 140 knots, and the rate of descent varied between 820 and 670 feet per minute. The vertical load factor varied between +0.97 and +1.04G. The pitch angle varied between +1.8 and +2.4 degrees (nose up). No significant drift angle was recorded nor the lateral load factor variation. The roll angle varied between -1.4 degrees (left wing down) and +1.1 degrees (right wing down). The heading varied between 281 and 283 degrees (QFU[10] 283 degrees). The Aircraft was on the localizer and the glide slope.

The crew disengaged the autopilot when the Aircraft was descending through approximately 730 feet AAL, at a distance of 1.9 nautical miles DME. The Commander, as the pilot flying, then controlled the Aircraft manually with autothrust engaged in 'SPEED' mode and the speed target was managed. He was aware of the perturbation of the glideslope signal and he therefore used the PAPI lights to maintain the glide path of the Aircraft.

[10] QFU: runway heading

Between 1,000 feet and 170 feet AAL, the average wind recorded was from 264 degrees with a speed of 12 knots. This gives an average headwind component of approximately 11 knots, and an average crosswind component from the left of approximately 3 knots, as shown in figure 9. The Aircraft did not encounter adverse wind conditions during the second approach and landing.

As the Aircraft descended below 170 feet AAL, the recorded wind information could be used to determine a trend. The wind trend information gave an indication that the headwind had changed to a slight tailwind. The Commander did not notice this change. He had last reviewed the wind information when the Aircraft was at approximately 1,500 feet pressure altitude, and the wind was the same as reported by the Tower Controller. After touchdown, the wind information was unreliable.

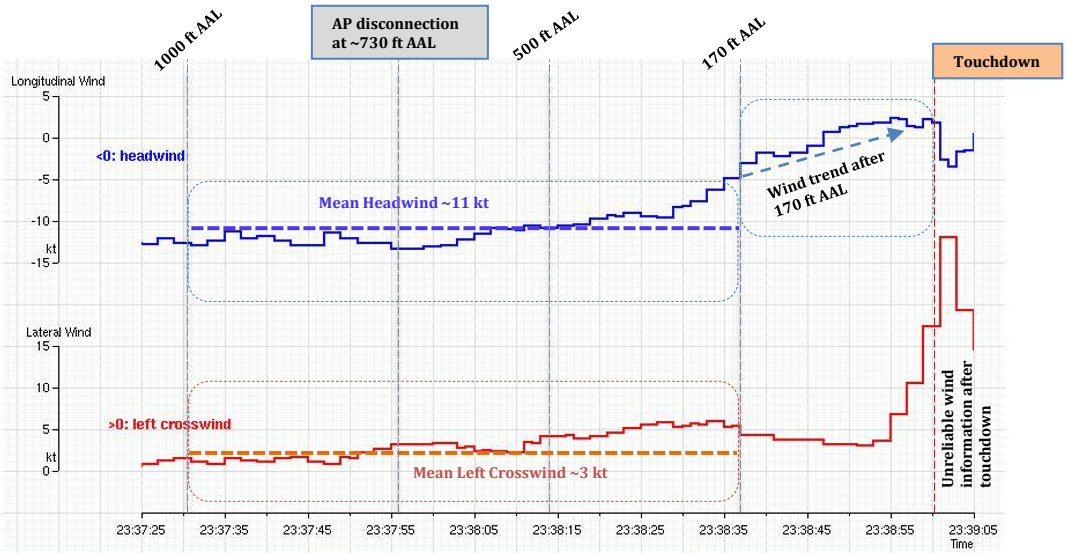


Figure 9. Wind information on short final approach

At 15 feet AAL, the Commander applied left rudder leading to a dynamic motion on the yaw axis. This dynamic motion had a significant effect on the recorded crosswind trend, which from that point could not be considered as trend information.

Between 730 feet (at 2337:55) and 100 feet (at 2338:44), the speed target was managed and varied between 138 and 139 knots. The indicated airspeed varied between 140 and 136 knots. The Commander's sidestick inputs varied from around 1/4 full nose-up to around 1/3 full nose-down. The pitch angle varied between +1.4 and +4.1 degrees (nose up). The rate of descent varied between approximately 900 and 560 feet per minute. The vertical load factor varied between +0.95G and +1.07G. The roll angle varied between -2.8 degrees (left wing down) and +3.2 degrees (right wing down). The heading varied between 280 and 282 degrees (QFU 283 degrees). The drift angle varied between +1.1 and +2.6 degrees (the Aircraft nose to the left of track).

As the Aircraft descended through 460 feet AAL, the glide slope deviation increased from 1/2 dot below the profile to 4/5 dot above the profile within 11 seconds. At the same time, the rate of descent increased from 700 feet per minute to 800 feet per minute. Similarly, to the first approach, during the second approach, the glide deviation was not consistent with the change of rate of descent. In this case, the glide deviation moved increasingly above the profile as the rate of descent increased. It is suspected that a perturbation of the glide slope signal occurred.

At the same time, the localizer deviation varied between 1/2 dot to the right and 1/2 dot to the left of the localizer with a high frequency. It is suspected that a perturbation of the localizer signal occurred.

The Commander stated that he announced “Continue” at minima. When the Aircraft was above the threshold at around 50 feet AAL, it was aligned on the runway centerline with negligible drift angle and around 1 degree roll angle. The Commander was able to see the left and right runway edge lights clearly as he had looked outside after the Aircraft passed 100 feet AAL. After the Aircraft passed the threshold, the Commander felt that the rain intensity increased, and it became heavier than light rain. The Aircraft started to drift to the right of the runway centerline.

Between 100 feet and touchdown, the Commanders’ sidestick inputs varied between 3/4 full nose-up and 1/5 full nose-down deflection. The pitch angle gradually increased from +3 to +5.5 degrees. Several applied nose-up inputs of up to 3/4 full deflection led to a progressive lowering of the rate of descent from 630 feet per minute to 130 feet per minute. The rate of descent then increased again to 240 feet per minute. On touchdown, the rate of descent was between 120 and 180 feet per minute. Lateral sidestick inputs varied between around 2/5 full right deflection to around 1/4 full left deflection.

The Commander applied several right roll inputs that led to a continuous right roll for approximately 8 seconds after the Aircraft crossed the threshold. The roll angle varied up to +4 degrees (right wing down). The sustained right roll angle led to an increase to the right in the Aircraft track and localizer, which resulted in the Aircraft deviating to the right of the runway centerline.

The Commander was focused more on the Aircraft pitch attitude during the flare, since he was confident that the Aircraft was aligned on the runway centerline when it was above the threshold. The windshield wipers were used and functioned properly on both sides. However, due to the increase in rain intensity, the Commander’s view of the runway edge lights became blurred. As the runway was not equipped with centerline lighting, his ability to judge whether the Aircraft was still aligned on the centerline was affected. The Investigation believes that the Commander applied several roll inputs to the right unintentionally after the Aircraft crossed the threshold, as he stated that he did not feel a wing bank during flare. From the flight data, it revealed that a slight Aircraft roll to the right continuously occurred, as shown in figure 10. Additionally, the slight left crosswind component (3 knots or less) contributed in a minor way to drive the Aircraft to the right side, away from the centerline.

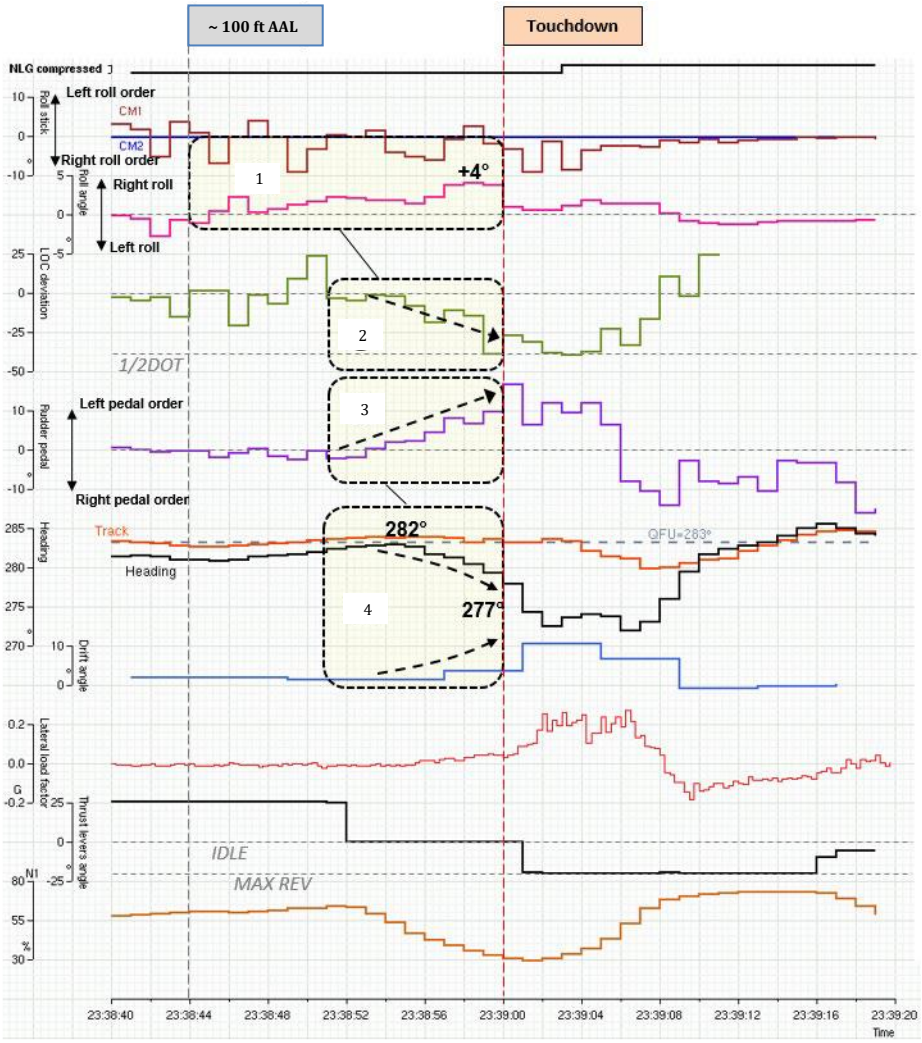
The landing flare was intentionally relatively long, as stated by the Commander, due to the heavy weight of the Aircraft, which was approximately 64,050 kg, and the up-slope of the runway.

During the flare, as the Aircraft was at 20 feet radio altitude, the thrust levers were set to idle. Since the autopilots had been disengaged the landing was a manual landing, and therefore, the flight guidance system generated a RETARD callout at 20 feet radio altitude as a reminder. The Commander was aware of the required action and he retarded the thrust levers to idle at the same time as the RETARD callout was generated.

At about 15 feet AAL, the Commander realized that the Aircraft was on the right side of the runway as he observed that the left hand edge lights became more blurred than the lights on the right hand side. This was one second after he retarded the thrust levers to idle. The Commander progressively applied a left rudder pedal input of up to 2/3 full deflection. The Commander tried to recover the Aircraft to the centerline of the runway. The left rudder pedal input led an increase in the drift angle from 1 to 8 degrees (Aircraft nose to the left of track) and a heading change from 282 to 277 degrees. The Commander’s control inputs resulted in no significant change to the aircraft trajectory to cancel the lateral deviation.

The Investigation believes that when the Commander realized that the Aircraft had drifted away to the right of the runway centerline, he should have also used left roll control inputs within the recommended limitation to recover the Aircraft to the centerline.

In this case, the use of left rudder only without left lateral input, as the Aircraft lateral flight path had already drifted away from the runway centerline, did not allow for an easy realignment back to the centerline before touchdown. The optimum technique is explained in the *Flight Crew Techniques Manual (FCTM)*.



Note:

1. Several right roll inputs over around 8 seconds of up to 4 degrees
2. Aircraft deviated to the right of the runway centerline
3. At approximately 15 feet above the runway, left rudder pedal input was progressively applied up to 2/3 full deflection
4. Drift angle increase from 1 to 8 degrees and heading change from 282 to 277 degrees

Figure 10. Lateral axis – from 100 feet to touchdown

From his seat position, the Co-pilot, as the pilot monitoring, stated that he was aware, despite the increase in rain intensity, that the Aircraft was tracking to the right of the runway centerline after passing the threshold. However, he did not advise the Commander or attempt to draw the attention of the Commander to the situation. According to the SOP contained in the *FCTM*, if, for any reason, one flight parameter deviates from stabilized conditions, the pilot monitoring will make a callout. The Investigation recommends that the Operator enhance crew resource management training by placing particular emphasis on the need for assertiveness

of callout(s) to be made by the pilot monitoring, particularly when there is any deviation from flight parameters.

There were localizer fluctuations before the vertical FLARE mode was displayed on the FMA (flare mode engagement). However, after the flare mode was displayed on the FMA and the Aircraft crossed over the threshold, there was a localizer trend showing that the Aircraft had deviated to the right of the runway centerline.

The Aircraft touched down approximately 910 meters beyond the threshold of runway 28, which was slightly outside the touchdown zone (900 meters from the threshold). According to the SOP in the *FCTM* regarding approach and landing techniques, if a normal touchdown distance is not possible, a go-around should be performed.

On touchdown, the right main landing gear touched down first followed by the left main landing gear with a vertical load factor of 1.3G and the localizer deviation was approximately 1/3 dot to the right of the runway. The Aircraft pitch angle was 5.6 degrees up. The ground spoilers then started to extend. The Aircraft had a 1 degree roll angle of right wing down, 8 degrees drift angle with the nose towards the left of track and a 0.25G lateral load factor with a heading of 277 degrees. The airspeed was 130 knots and the rate of descent was approximately 180 feet per minute.

The Aircraft lateral position was computed at touchdown based on the localizer deviation. Considering the Aircraft distance from the threshold of runway 28 (around 910 meters), the runway length, and the Aircraft localizer antenna position (located under the radome), the Aircraft lateral position was approximately 14.5 meters to the right of the runway centerline.

Based on the drift angle and Aircraft geometry, the right main landing gear position was approximately 20.5 meters on the right of the runway centerline. The left main landing gear position was approximately 13 meters to the right of the runway centerline. With a runway width of 45 meters, the side strip marking (runway edge line) was at 22.5 meters to the right of the runway centerline.

This means that the localizer antenna (at the cockpit level) was approximately 8 meters from the edge line, and with the left drift angle of 8 degrees at touchdown, the right main landing gear outboard wheel was close to the right side stripe marking of the runway and approximately two meters from the runway edge line (runway shoulder), inside the runway.

After touchdown, the pitch-up input was released and a pitch-down input up to around 1/3 full deflection was applied by the Commander. This action led to a decrease in pitch angle towards zero degree, and the nose landing gear touched down approximately one second after the main landing gear touchdown. The ground spoilers fully extended and medium autobrake activated. Approximately half a second after touchdown, maximum reverse (MAX REV) thrust was applied for around 15 seconds.

Left rudder pedal input was applied when the Aircraft was at approximately 15 feet AAL, and continued after the touchdown, leading the heading to decrease to 272 degrees, and the drift angle to the left (nose towards the left of the track)) increased to 11 degrees. Due to the continued left rudder pedal input, the lateral (localizer) deviation reached around 1/2 dot maximum, approximately four seconds after touchdown.

The runway condition was wet, consistent with the moderate/heavy rain that occurred during the landing and as reported in the METAR. As the runway was wet, and given the relative lateral movement and significant drift angle of the Aircraft at touchdown, a lateral runway excursion occurred.

Multiple load factor peaks were recorded as the right main landing gear struck the edge lights. The first edge light was struck less than one second after touchdown. Five edge lights were struck within the next 1.5 seconds.

The brake pressure of the right main landing gear inboard wheel remained at 200 psi, whereas the brake pressure of the other wheels increased progressively up to 2,300 psi. Therefore, the right main landing gear inboard wheel tire was, most probably, damaged due to contact with the edge lights. The right main landing gear outboard wheel tire was found to have significant wear and partial ply separation, most likely, due to the higher load carried as a consequence of the Aircraft lateral movement on the ground over at least five seconds.

Based on the post flight report (Appendix 1), it states that at 23:39, the WHEEL TYRE LO PR alert, both CHECK TIRES 3 PRESS2651GM and CHECK TIRE 3 PRESS 2651/2652GM failure messages were activated. These messages were in line with the right main landing gear inboard wheel tire behavior recorded by the FDR and the reported damage to the right main landing gear inboard and outboard wheel tires in the technical log book.

There is a shoulder of approximately 7.5 meters between runway side stripe marking (edge line) and unpaved surface. The edge lights are placed around 2.5 meters from the side stripe marking. Based on the wheel geometry, the maximum lateral runway excursion of the right main landing gear was approximately 3.2 meters beyond the runway edge line. In that case, the maximum lateral runway excursion of the right main landing gear outer wheel tire was approximately 3.7 meters beyond the runway edge line, or around half the width of the shoulder.

The localizer deviation started to reduce toward zero when rudder pedal input to the right of up to approximately 1/3 of full deflection was applied. The rudder input started five seconds after touchdown. The Aircraft progressively tracked towards the centerline and re-aligned with the runway heading. An increase in the heading from 272 to 285 degrees occurred, and the drift angle decreased from 11 degrees towards zero.

The Aircraft was recovered parallel to the runway centerline (slightly to the left of the centerline) approximately 1,500 meters beyond the threshold of runway 28 at a groundspeed of approximately 83 knots (computed airspeed was about 72 knots).

Manual braking was applied 22 seconds after touchdown when the groundspeed was 19 knots. The application of manual braking led to disengagement of the autobrake. The Aircraft then continued to decelerate and exited the runway via taxiway Bravo. The Aircraft taxied to the stand uneventfully.

The Aircraft was taxied at a maximum speed of seven knots and 30-degree nose wheel steering angle, as per the *FCOM* for taxi with deflated or damaged tires, to the parking stand. After the Aircraft stopped on the parking stand, the flight crew reported the condition of the right main landing gear tires to the Tower Controller.

The Investigation believes that the Commander expected that the Aircraft would have remained aligned on the centerline (expectation bias[11]) during the flare, since the Aircraft had already been aligned on the centerline as it overflew the threshold. His expectation bias was reinforced by the reduction in visibility over the threshold due to the increase in rain intensity, and the lack of runway centerline lighting. The Investigation believes that the reduction in visibility and the minimum runway lighting adversely affected the Commander's situational awareness. Since the Commander gave more attention to the Aircraft pitch angle during the flare, the right roll input was, most probably, unintentionally applied due to a reduction in his situational awareness. The application of roll input to the right was believed to be a subconscious action.

The Commander started to realize that the Aircraft was on the right side of the runway due to his vision of the left edge lights becoming more blurred in comparison to his visibility of the lights on the right hand side.

[11] Expectation bias is defined as having a strong belief or mindset towards a particular outcome

The Commander stated that few seconds after he decided to continue the landing he realized that the Aircraft was drifting away to the right of the centerline. He reduced the thrust levers to idle, and within one second, the Commander took actions by applying continuous left rudder pedal input in an attempt to bring the Aircraft to the centerline. He applied maximum reverse thrust after touchdown. The Investigation believes that the nature of the Commander's incomplete control input can be explained by the high workload when applying the left rudder pedal input, and most probably, the surprise effect of the unexpected lateral deviation of the Aircraft position, such that he overlooked the need to combine roll control input to the left before touchdown.

The Commander was aware of the need to immediately apply reverse thrust after touchdown. Within five seconds after touchdown, the Commander still applied left rudder pedal input. Thereafter, he applied right rudder pedal input to recover taking the Aircraft towards the centerline. The recovery action was relatively late, which was most probably due to the existing high workload, including to understand the Aircraft state, in the 5-second period after touchdown.

The Aircraft touched down slightly beyond the touchdown zone, which is believed to have occurred due to the decrease in visibility and the Aircraft drift to the right, which surprised the Commander. Additionally, the Commander was not aware of the trend of the wind change from a 6-knot headwind component to a slight tailwind component.

Since the CVR recording of the Incident flight was not available to the investigation, it was not possible to determine whether all required briefings, checklists, tasks sharing, and verbal announcements (including system callouts), took place.

According to the SOP regarding to *Approach Using LOC G/S Guidance on Final Approach* in the *FCOM*, below minimum the visual references must be the primary reference until landing and if visual references are not sufficient, the flight crew should initiate a go-around. According to the SOP regarding *Considerations About Go-around* in the *FCTM*, the flight crew must consider performing a go-around if there is a loss of, or doubt about, situational awareness, or the stability of the approach is not maintained until landing. Therefore, the Investigation recommends that the Operator emphasizes the importance of the *Approach Using LOC G/S Guidance on Final Approach* SOP, and the *Considerations About Go-around* SOP during training.

2.4 Runway Condition

As the runway was not equipped with centerline lighting, the approach and landing in IMC was a challenging one in the prevailing weather conditions.

The Commanders' intention to land the Aircraft on or close to the runway centerline was affected due to his blurred visibility of the edge lights because of the rain intensity, and because of the lack of runway centerline lighting that he could have used as a reference. It is most likely that there was standing water on the runway.

The *Route Information Manual*, contained a caution about fluctuating ILS glideslope performance. During the first approach, the Aircraft experienced glideslope fluctuations for six seconds until the approach mode changed from glideslope track (G/S) to landing (LAND) mode, even after arming and ensuring the localizer capture as recommended. At the same time, fluctuation of the localizer occurred until the go-around was initiated.

On the second approach, the Aircraft experienced glideslope fluctuations for approximately 12 seconds until the approach mode changed from glideslope track (G/S) to landing (LAND) mode. Localizer fluctuation occurred to an even greater extent than during the first approach. The localizer fluctuation started when the approach was already in localizer track (LOC) and glideslope track (G/S) modes. It then continued for approximately two minutes and 38 seconds until the flare (FLARE) mode started.

Since localizer fluctuation is not stated as a caution in the *Route Information Manual*, it is recommended that the Operator include information about the possibility of localizer fluctuation in the *Route Information Manual* to assist in maintaining pilot situational awareness.

After the Incident, resulting from the application of its SMS processes, the Operator highlighted its concern to Calicut Airport Authority regarding the airport infrastructure limitations, which were identified as being contributory to the Incident.

2.5 Flight Crew Performance

The Operator incorporated SAFE[12] software to measure pilot fatigue, which included a well-established subjective measuring system using the Samn-Perelli seven-point fatigue scale (SPS). The predicted level of alertness around the time of the landing to VOCL was almost on SPS 5.0 which means “moderately tired, let down”[13] for both flight crewmembers. The SAFE prediction was considered to be in line with the flight crew feedback regarding their level of alertness.

Based on circadian rhythm studies and research, during the early morning between 2 am to 6 am, human biological functions and performance efficiency are at their lowest level. It has been demonstrated that human behavioral function variations related to circadian rhythms occur in the areas of alertness, reaction time, short-term memory, long-term memory, search tasks, vigilance and sleep.

The Incident occurred at 2339 UTC (0339 UAE local time), the worst time from a circadian rhythm perspective. When human performance efficiency is degraded, the risk of inaccuracy in conducting a challenging or demanding task increases.

The flight crew carried out the landing in a more task demanding situation than a normal landing, based on:

- the available data related to both pilots’ fatigue level measurement and circadian rhythm condition;
- landing the Aircraft on a runway without centerline lighting in moderate/heavy rain and IMC;
- a trend of wind changed from a headwind to a tailwind of which the pilot flying was not aware; and
- the airport location on a hilltop with terrain on both sides.

In this case, the landing in these conditions resulted in an incident. The Investigation believes that given these conditions, the Operator needs to take more measures to mitigate the risks of operating at Calicut. Therefore, the Investigation recommends that the Operator and the airport authority reinforce safety measures in order to mitigate risks for VOCL operations, with particular reference to operations during the Monsoon season, from June to September.

For this flight, the Commander, an experienced Captain, was paired with a Co-pilot who could be considered to be relatively inexperienced. Referring to the Operator’s standard operating procedures that are clear regarding the tasks and responsibilities for a pilot flying and pilot monitoring position, the Co-pilot should have advised the Commander or attempted to draw the attention of the Commander to the situation during the flare.

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12 SAFE is an acronym for the System for Aircrew Fatigue Evaluation: a computer program that includes a suite of algorithms that allow a range of factors influencing alertness in aircrew to be evaluated.

13 SPS 5.0 or ‘Moderately tired, let down’ means: Moderate fatigue, performance impairment possible. Flying duty permissible but not recommended unless urgent. The description refers to Report SAM-TR-82-21, Title: Estimating Aircrew Fatigue: A Technique with Application to Airlift Operations – USAF School of Aerospace Medicine.

2.6 Cockpit Voice Recorder (CVR) Preservation

After landing at VOCL, the plan was to operate a return flight to OMAA with the same flight crew and cabin crew.

After the engines were shut down at 2347, the auxiliary (APU) remained engaged for the parking checklist.

The ground engineer was requested by the Commander to check the right wheel tires since the pressure of No.3 tire showed zero pressure on the ECAM, and the flight crew was then informed about the deflation of the No.3 tire, and the No.4 tire was worn beyond limits with some tread separation.

The Aircraft had already landed late and the ground engineer informed the flight crew that changing the tires would take about 45 minutes. The standard time of departure (STD) was 0015, and was not changed.

The flight crew discussed the damaged tires and their duty time. However, they did not know that the Aircraft had hit the runway edge lights. In order to gain time, the Co-pilot started to conduct the cockpit preparation for the return flight to Abu Dhabi. The Commander went outside to check the tires.

In the meantime, the station manager came on board and the Commander asked the station manager to contact ATC immediately by phone and advise that the Aircraft had suffered a tire burst and therefore there was probably foreign object debris (FOD) on the runway.

The Commander went outside to check the damaged tires and saw that the engineers had started to replace the wheels. While the tires were being replaced by the engineers, the Commander was invited by aerodrome personnel to see the damaged runway edge lights struck by the Aircraft, to which he agreed.

After seeing the damaged runway edge lights, the Commander returned to the Aircraft and asked the station manager to call the maintenance department in Abu Dhabi and the NOC, and to inform them that the wheels needed to be changed due to the damaged tires that caused by striking some runway edges lights. The Co-pilot stayed in the Cockpit while the wheels were changed and the Aircraft was refuelled. The Commander stayed outside and was involved in making many telephone calls related to the occurrence.

At this time, everything seemed normal. After changing the wheels, as a safety measure, the Operator's Maintenance Department called Airbus and requested assistance in order to release the Aircraft for the return flight. Airbus then requested additional maintenance checks to be conducted before the release of the Aircraft. There was then some confusion as to whether the passengers should board. However, the passengers had started to board. The Commander was still outside the cockpit, which meant that he did not perform any preparation in the cockpit for the return flight, as he had already delegated to the Co-pilot. The Investigation believes that the flight crew should have taken action to preserve the CVR as soon as they were informed of the damage to the runway edge lights.

The return flight passengers started boarding the Aircraft at about 0200 UTC. In the meantime, a conference call was held by the Operator's incident management team (IMT). The conference call started at approximately 0225 UTC and the decision to cancel the flight was taken after the conference call at around 0300 UTC. Before the flight cancelation decision was made, the crew believed that they would be flying back.

The additional maintenance checks on the right landing gear required tools to simulate the landing gear extension and retraction. Because of the additional maintenance checks, the Aircraft was not ready on time for the return flight.

The request to quarantine the flight recorders was made after the flight cancellation decision took place, as concluded during the IMT conference call. The company pilot duty manager (PDM) was first informed of the incident by a member of the IMT following the conference call. The PDM was in consultation with all parties including the company VP Corporate Safety & Quality (VP-CSQ) who informed him that VP-CSQ had instructed the IMT to preserve and to ensure protection of the flight recorders, including the CVR.

The PDM then communicated with the Commander for the first time after his communication with the member of the IMT. The seriousness of the event was mutually understood between the Commander and the PDM. The Commander sought PDM advice on continuing operations as he reported that the flight and cabin crew were fit and willing to operate for the return flight. The PDM advised the Commander to begin the process of standing down while the PDM coordinated with the various company departments. The PDM also advised the Commander to start gathering his thoughts and submit an air safety report (ASR).

The Co-pilot had already started the transit checks as is standard during a turnaround flight, because he would have been the pilot flying for the return flight. As part of the pre-flight checks, the CVR recording was selected to the ON position. It revealed that the CVR was switched ON at 0016:24 and this was more than two hours before the IMT conference call was commenced. The CVR was left running until the engineer pulled the circuit breaker after the decision was made to quarantine the flight recorders. It revealed that the flight recorders were switched off at 0318:02.

Following the Incident, the Commander did not preserve the flight recorders (FDR and CVR) in time, as per the requirements of *CAR-OPS 1* of the *Civil Aviation Regulations* and the *Operations Manual – Part A* (see sub-section 1.17.4 and 1.18.1 of this Report).

Since the CVR had only two hours recording capability, the available data on the CVR covered the last two hours of the preparation time on the ground for the return flight, and the recorded data from the Incident flight had been overwritten.

The FDR had a recording capability of 72 hours. Therefore, the flight data for the Incident flight was available and was useful to the Investigation.

The Investigation believes that once the Commander had become aware that the tire damage was due to the impact with the runway edge lights, the Commander could have instructed the Co-pilot to switch the CVR off in order to preserve the remaining information on the unit.

In order to prevent a reoccurrence of failure to preserve flight recorders the Investigation recommends that the Operator re-inforce among its pilot body the requirement to preserve flight data and information recordings as per the *CAR-OPS1* and the *Operations Manual*.

3. Conclusions

3.1 General

From the evidence available, the following findings, causes, and contributing factors were made with respect to this Incident. These shall not be read as apportioning blame or liability to any particular organization or individual.

To serve the objective of this Investigation, the following sections are included in this part of the Report:

- **Findings.** Are statements of all significant conditions, events or circumstances in this Incident. The findings are significant steps in this Incident sequence but they are not always causal or indicate deficiencies.
- **Causes.** Are actions, omissions, events, conditions, or a combination thereof, which led to this Incident.
- **Contributing factors.** Are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the Incident occurring, or mitigated the severity of the consequences of the Incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil or criminal liability.

3.2 Findings

3.2.1 Findings relevant to the Aircraft

(a) The Aircraft was certificated, equipped, and maintained in accordance with the requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

(b) On touchdown, the Aircraft was to the right of the runway centerline with the right main landing gear outboard wheel approximately two meters inside the runway shoulder (side stripe runway marking).

(c) The right main landing gear inboard wheel tire was damaged and punctured due to contact with runway edge lights.

(d) The maximum lateral runway excursion of the right main landing gear outer wheel tire was approximately 3.7 meters outside the runway edge line, or around half of the width of the runway shoulder.

(e) The outboard tire was significantly worn and had partial ply separation due to the higher load imposed as a consequence of the lateral movement of the Aircraft over the runway surface.

3.2.2 Findings relevant to flight operations

(a) During the first approach, the last reported visibility by air traffic control (ATC) was 3,000 meters. It was 2,000 meters during the second approach.

(b) During the flare, the Commander, as the pilot flying (PF), unintentionally applied several right roll inputs that led to a continuous right roll, which resulted in the Aircraft deviating to the right side of the runway.

(c) When the Commander realized that the Aircraft was on the right side of the runway, he applied left rudder pedal input progressively up to 2/3 full deflection in an attempt to recover the Aircraft to the runway centerline.

(d) This Commander's inputs caused an increased left drift angle of up to 8 degrees at touchdown (Aircraft nose towards the left of track). The pilot flying inputs did not alter the Aircraft trajectory and failed to counteract the increasing lateral deviation, since no left roll control input accompanied the rudder inputs.

(e) The landing flare was relatively long, which was intentionally performed by the Commander due to the heavy weight of the Aircraft, and the up-slope of the runway.

(f) Initially a continuous left rudder input was applied after touchdown. Five seconds after touchdown, a rudder pedal input to the right of up to approximately 1/3 full deflection was applied to reduce the drift angle and further align the Aircraft with the runway centerline heading.

3.2.3 Findings relevant to the flight crewmembers

(a) The flight crewmembers were licensed and qualified for the flight in accordance with the existing requirements of the *Civil Aviation Regulations* of the United Arab Emirates.

(b) During the first approach, the Commander made a decision to perform a go-around based on his perception of a risk of hydroplaning on the runway due to the heavy rain and the possibility of standing water.

(c) During the second approach, when the Aircraft was above the threshold, it was aligned on the runway centerline, and the Commander was able to see both left and right runway edge lights clearly.

(d) During the flare, with the increase in rain intensity and the lack of centerline lighting, the Commander's ability to see the centerline was degraded.

(e) The Commander expected that the Aircraft would have remained on the centerline during the flare and at touchdown, since it had already been aligned when flying over the threshold.

(f) When the Aircraft was approximately 15 feet above the runway, the Commander realized that it was drifting away towards the right hand side of the runway having observed that the left edge lights became more blurred than the right side ones.

(g) The Commander could not react in a timely manner to re-align the Aircraft because he was surprised by the unexpected deviation to the right and the already high workload when attempting to recover the Aircraft by applying an incorrect flight control technique before touchdown.

(h) The Aircraft touched down slightly beyond the touchdown zone due to the decrease in visibility. Additionally, the Commander was not aware of the trend as the wind changed from a 6-knot headwind component to a slight tailwind component.

(i) Within five seconds after touchdown, the left rudder pedal input continuously applied, which was not effective to recover the Aircraft drift and this is believed to have been due to the existing high workload. Thereafter, he applied right rudder pedal input, which resulted in recovery of the Aircraft towards the centerline.

(j) The Co-pilot, as the pilot monitoring, was aware that the Aircraft was deviating to the right of the runway centerline after crossing the threshold. However, he did not announce the deviation to attract the Commander's attention, which was not in accordance with the standard operating procedure.

(k) After becoming aware of the severity of the Incident, the Commander did not preserve the flight recorder (CVR) in time, which was not as per the requirements of CAR-OPS 1 and the procedures in the Operator's *Operations Manual – Part A*.

(l) The Commander, a very experienced Captain, was paired with a Co-pilot who could be considered to be relatively inexperienced.

3.2.4 Findings relevant to the Operator

(a) The Operator utilized an approved safety management system to minimize safety risk in its operations.

(b) Prior to commencement of operations to Calicut airport in 2009, the Operator carried out a basic safety risk assessment process for determining risk controls and its implementation.

(c) Following the Incident, the Operator highlighted its concern to Calicut Airport Authority regarding the airport infrastructure limitations, and some safety actions were taken by the Operator for its operation to VOCL.

3.2.5 Findings relevant to the Airport

(a) There was a perturbation in the glide slope and localizer signals during both approaches at lower altitude, below 460 feet AAL.

(b) There was a reduction in visibility after the Aircraft crossed the threshold due to the increase in rain intensity.

(c) There was standing water on the runway during landing.

3.3 Causes

The Air Accident Investigation Sector (AAIS) determines that the cause of the Incident was:

After crossing the threshold, the Aircraft drifted towards the right side of the runway due to a slight but continuous roll input to the right. The Aircraft touched down almost at the runway edge line, and this was followed by an increase in lateral deviation towards the runway edge due to an ineffective flight control recovery technique. The Aircraft then struck and damaged five runway edge lights as the right main landing gear entered the runway shoulder.

3.4 Contributing Factors to the Incident

The Air Accident Investigation Sector identifies the following contributing factors to the Incident:

(a) The presence of a moderate intensity rain shower over the runway during the landing affected visibility after the Aircraft crossed the threshold.

(b) The lack of runway centerline lighting.

(c) The situational awareness of the Commander, as the pilot flying, was adversely affected by his expectation that the Aircraft would remain aligned with the centerline until touchdown, since the Aircraft was aligned when he overflew the centerline at the threshold. The alignment deviation occurred because of the reduction in visibility over the threshold, and the lack of runway centerline lighting that resulted in a loss of visual references.

(d) The several unintentional roll inputs to the right applied due to a subconscious action, since the pilot flying focused more on the Aircraft pitch attitude during the flare and the reduction in pilot flying situational awareness.

(e) Control inputs to re-align the Aircraft were not affirmative in that only incremental left rudder inputs were made without an associated left roll. A continuous increase in the Aircraft lateral deviation movement was a result of the ineffective flight control technique, and this was due to the existing high workload and the surprise effect of the unexpected Aircraft lateral deviation position such that the pilot flying overlooked the approved flight control technique before touchdown.

(f) The recovery action to take the Aircraft back to the centerline by applying right rudder input after touchdown, was relatively late due to the high workload. Initially the pilot flying applied an incorrect continuous left rudder input after touchdown.

(g) Despite his awareness of the deviation to the right of the runway centerline, the Co-pilot, as the pilot monitoring, did not intervene to attract the attention of the Commander. This was not in compliance with standard operating procedures.

4. Safety Recommendations

4.1 General

The safety recommendations listed in this Report are proposed according to *Air Accident and Incident Investigation Regulations*, and provision 6.8 of *Annex 13 to the Convention on International Civil Aviation.* The safety recommendations are based on the conclusions listed in Part 3 of this Report. The Air Accident Investigation Sector expects that all safety issues identified by the Investigation are addressed by the concerned organizations.

4.2 Safety Actions

Safety actions were taken by the Operator following the Incident. These are based on the findings of the Operators' internal evaluation.

1. Special considerations for arrival were added and emphasized more in the *Route Information Manual - Airport Briefs* for Calicut, as following:
   - The word 'Caution' about the actions required to avoid ILS glideslope fluctuation, was highlighted in red, to draw the attention of the reader. The revised Caution becomes:

     "*Caution:* Due to fluctuating ILS Glideslope performance, Crews shall first arm and capture LOC mode when established on a final intercept heading to the inbound course (not before). Only when established on the LOC, Crews may then arm the APP mode after ensuring the correct sensing of the G/S indications."

   - Additional special considerations for Calicut Airport are included regarding the following:
     - Autopilot use for ILS approaches below 400 feet above aerodrome level is not recommended.
     - Flight Director guidance use below 400 feet above aerodrome level is to be used with extreme caution.
     - Tower reported surface winds are inaccurate and unreliable.
     - **"In all cases, pilots must aim to touchdown within the touchdown zone, or a go around must be initiated."**
2. In the *Route Information Manual – Destination Airport Categories*, it is added that only a captain performs the landing in Calicut. However, if the captain is an instructor (NOM, TRI, TRE), he/she may allow the co-pilot to perform the landing.

4.3 Final Report Safety Recommendations

4.3.1 Safety recommendations addressed to Etihad Airways

SR69/2020

The Co-pilot, as the pilot monitoring, was aware that the Aircraft was tracking to the right of the runway centerline after crossing the threshold. However, he did not intervene to draw the attention of the Commander to the situation, which was not in accordance with the *Trajectory Stabilization in the Final Approach* standard operating procedure.

It is recommended that the Operator enhance crew resource management training by placing particular emphasis on the need for assertiveness of callout(s) to be made by the pilot monitoring, particularly when there is any deviation from flight parameters.

SR70/2020

The Operator should emphasize during training the importance of the *Approach Using LOC G/S Guidance on Final Approach* standard operating procedure as per the *Flight Crew Operating Manual (FCOM)*, and the *Considerations About Go-around* standard operating procedure as per *Flight Crew Techniques Manual (FCTM)*.

SR71/2020

Perturbation or fluctuations of the localizer signal occurred during both approaches, and this is not stated as a *Caution* in the *Route Information Manual*. Therefore, it is recommended that the Operator include information about the possibility of localizer fluctuation in the *Route Information Manual* to assist in maintaining pilot situational awareness.

SR72/2020

The flight crew carried out a challenging landing considering the available data of the pilots' fatigue level, measurement and circadian rhythm condition, landing the Aircraft at a runway without centerline lighting in moderate to heavy rain and Instrument meteorological conditions (IMC), a trend of wind changed from headwind to tailwind, and at an airport location on a hilltop with terrain on both sides.

It is recommended that the Operator should carefully examine VOCL operations including arrival time and devise appropriate safety measures to mitigate the associated risks, especially during the Monsoon season.

SR73/2020

After becoming aware of the severity of the Incident, the Commander did not preserve the cockpit voice recorder (CVR) in time. The Co-pilot carried out the preparation in the cockpit as he would have been the pilot flying for the return flight. As part of the pre-flight checks, the CVR recording switch was selected to the ON position. The CVR was left running until the decision was made to cancel the flight. In consequence, as the CVR had a two-hour recording capability, important information relevant to the Investigation was overwritten and was therefore unavailable to the investigation.

It is recommended that the Operator re-inforce among its pilot body the requirement to preserve flight data and information recordings, which also include to develop policy for pulling the CVR circuit breaker after any safety incident and not to be turned ON until decided to do so.

4.3.2 Safety recommendation addressed to Calicut Airport Authority

SR74/2020

In relation to the airport environment, unusual weather condition, and infrastructure limitations such as the absence of runway centerline lightings, absence of full touchdown zone lighting system, and poor ILS signal quality; it is recommended that the Calicut airport authority carefully examine aerodrome operations and devise appropriate safety measures, or consider the practicability of the improvement of the airport infrastructure, in order to mitigate the associated risks.

This Report is issued by:

The Air Accident Investigation Sector
General Civil Aviation Authority
The United Arab Emirates

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Appendix 1. Post Flight Report

The post flight report of the flight is shown in figure A1.1.

```
A/C ID    DATE    GMT    FLTN       CITY PAIR
.A6-EIT   21JUN   1101   ETD10B     VOCL OMAA

+--------------------+
|    MAINTENANCE     |          DB/N
| POST FLIGHT REPORT |      EY32061704BDR
+--------------------+

A/C ID   DATE    GMT         FLTN       CITY PAIR
.A6-EIT  20JUN   1920/2341   ETD25B     OMAA VOCL

WARNING/MAINT.STATUS MESSAGES
-----------------------------
GMT  PH ATA
2339 08 32-00 WHEEL TYRE LO PR

FAILURE MESSAGES
----------------
GMT  PH ATA                                  SOURCE    IDENT.
1921 02 73-21-60 AFS:FADEC2                   AFS 1
2339 08 32-41-13 CHECK TIRE 3 PRESS2651GM     TPIS
2339 08 32-41-13 CHECK TIRES  3/4  PRESS      TPIS
                 2651/2652GM
```

Figure A1.1. Post flight report of the flight

Appendix 2. VOCL ILS Z Runway 28

The Calicut ILS Z runway 28 chart is shown in figure A2.1.

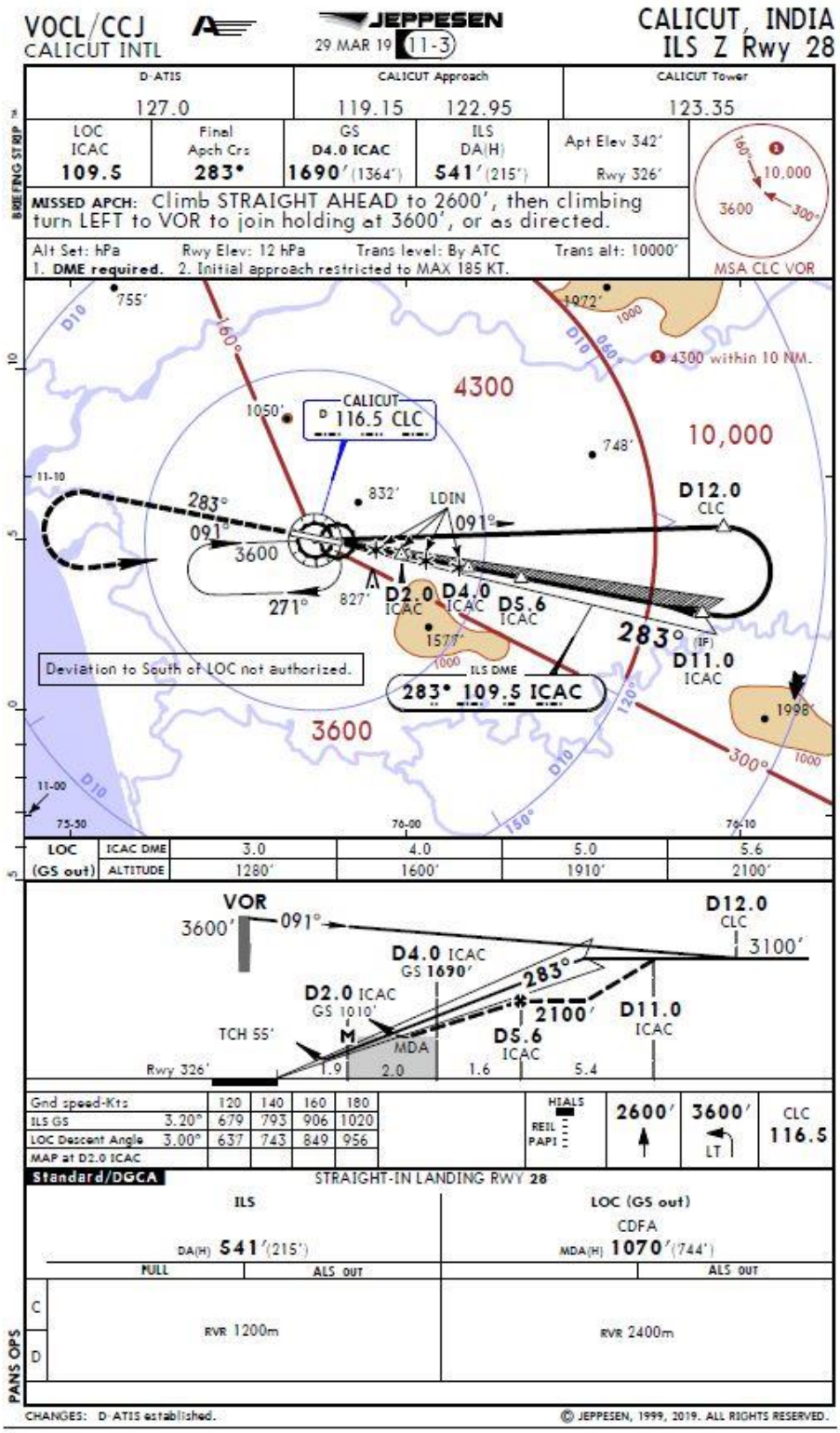

Figure A2.1. VOCL ILS Z runway 28 chart