

الهيئة العامة للطيران المدني
GENERAL CIVIL AVIATION AUTHORITY



Air Accident Investigation Sector

Accident

- Preliminary Report -

AAIS Case N° AIFN/0015/2023

Severe Turbulence Encounter In-Flight

Operator: Emirates Airlines
Make and Model: Airbus A380-861
Nationality and Registration: The United Arab Emirates, A6-EEV
Place of Occurrence: Male Airspace
State of Occurrence: Republic of Maldives
Date of Occurrence: 4 December 2023



Accident Brief

AAIS Report No.:	AIFN/0015/2023
Operator:	Emirates
Aircraft Type and Registration:	Airbus A380-861, A6-EEV
MSN:	150
Number and Type of Engines:	four, General Electric – GE90
Date and Time (UTC):	4 December 2023
Location:	Male Airspace (Republic of Maldives)
Type of Flight:	Commercial, Scheduled Passenger
Persons Onboard:	490
Injuries to Passengers and Crew:	5 serious injuries, 23 minor injuries
Other Injuries:	None
Nature of Damage:	Damage to the cabin

Investigation Objective

This Investigation is conducted pursuant to the United Arab Emirates Federal Act No. 20 of 1991, promulgating the Civil Aviation Law, Chapter VII – *Aircraft Accidents*, Article 48. It is in compliance with the *Air Accident and Incident Investigation Regulation (AAIR)*, and in conformity with *Annex 13* to the Convention on International Civil Aviation.

The sole objective of this Investigation is to prevent aircraft accidents and incidents. It is not the purpose of this activity to apportion blame or liability.

The information contained in this Preliminary Report is derived from the data collected during the ongoing investigation of the Accident. Later Interim Statements, if any, or the Final Report may contain altered information in case of appearance of new evidence during the ongoing investigation.

The Final Report may contain amended information when new evidence becomes available during the ongoing investigation.

Investigation Process

The occurrence involved an Airbus A380-861, registration marks A6-EEV, and was notified to the Air Accident Investigation Sector (AAIS) of the United Arab Emirates by a phone call to the Duty Investigator (DI) Hotline Number +971 50 641 4667.



An Investigation team was formed in line with the *Annex 13* obligations of the United Arab Emirates being the State of Registry and State of the Operator. The Investigation was delegated to United Arab Emirates by the Republic of Maldives, in writing, as the latter being the State of Occurrence.

After the initial investigation phase, the occurrence was classified as an 'Accident'.

The AAIS notified the Bureau of Enquiry and Analysis for Civil Aviation Safety (BEA) of France as of being the State of the Manufacture and Design. The BEA assigned an accredited representative assisted by advisers from the aircraft manufacturer.

The AAIS is leading the Investigation and will issue a Final Report when the Investigation is completed.

This Preliminary Report is publicly available at:

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

Notes:

- ¹ Whenever the following words are mentioned in this Report with the first letter Capitalized, it shall mean:
 - (Accident) – this investigated accident
 - (Aircraft) – the aircraft involved in this accident
 - (Commander) – the commander of the flight
 - (Copilot) – the copilot of the flight
 - (Investigation) - the investigation into this accident
 - (Operator) – Emirates
 - (Report) – this Preliminary Report.
- ² Unless otherwise mentioned, all times in this Report are in coordinated universal times (UTC).
- ³ Figures used in the text of 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 and Definitions

AAIS	Air Accident Investigation Sector of the United Arab Emirates
AIFN	Accident/incident file number
ATPL	Air transport pilot license
BEA	Bureau of Enquiry and Analysis for Civil Aviation Safety
CB	Cumulonimbus
CP	Control panel
CPDLC	Controller pilot datalink communication
CVR	Cockpit voice recorder
DFDR	Digital flight data recorder
EFIS	Electronic flight instrument system
FCOM	Flight crew operating manual
FCTM	Flight crew techniques manual
FIR	Flight information region
MFD	Multi-functional display
MSN	Manufacturer serial number
NOAA	National Oceanic and Atmospheric Administration
OM-A	Operations manual – Part A
OFP	Operational flight plan
OMDB	Dubai International Airport
PF	Pilot flying
PM	Pilot monitoring
PWS	Predictive wind shear system
QRH	Quick reference handbook
RT	Radio telephony
TURB	Turbulence
SEP	Safety and emergency procedures
UTC	Coordinated universal time
WAFC	World area forecast centers
WX	Weather
WXR	Weather radar system
YPPH	Perth International Airport



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1. Factual Information

1.1 History of the Flight

On 4 December 2023, Emirates Airbus A380-861 was scheduled to operate flight EK421, from Perth International Airport (YPPH), Australia, to Dubai International Airport (OMDB), the United Arab Emirates.

The flight crew consisted of the Commander, who was the pilot flying (PF), the Copilot, who was the pilot monitoring (PM), and augmenting captain who was occupying the third occupant seat in the cockpit behind the Commander and the Copilot.

The flight crewmembers reported to their duty fit and well-rested. As per the Commander's statement, he received the briefing package¹ ahead of time.

According to his statement, the Commander thoroughly reviewed the information related to the flight. He described the information provided on the day as, "not special"² given his extensive experience flying this particular route for long time.

The Commander stated that he conducted a briefing for the flight and cabin crew on the way to the airport. He informed the cabin crew about the weather conditions expected during the flight, but he did not highlight any specific instances of severe turbulence condition in flight since, as per his statement, there was no such information indicated in the operational flight plan (OFP).

The cabin supervisor, who was in charge of the business class, confirmed in her statement that there was no mention of the possibility of encountering severe turbulence during the briefing. Furthermore, the Copilot mentioned that no precautionary measures were discussed regarding severe turbulence during the flight, as the flight crew did not anticipate encountering such severe turbulence

The Aircraft took off from YPPH at 1428:53 UTC. The takeoff was uneventful and smooth, as per the statement of the augmenting captain. This was confirmed by the Investigation from the data retrieved from the digital flight data recorder (DFDR).

At 2029:35 UTC, the Aircraft entered Male flight information region (FIR) from SUNAN³ waypoint. The Commander stated that there was an off-path cell forming at the 11 o'clock position. During this time, the augmenting captain, who had taken over the PM role from the right seat as the Copilot was on a break, observed the off-path weather on the radar approximately 10 o'clock position, about 20 to 30 nautical miles away, and confirmed it was visually under clear skies. The augmenting captain also stated seeing clouds below the Aircraft, noting off-path weather about 10 nautical miles ahead as a low layer of clouds significantly below the Aircraft.

¹ Briefing Package: A term used to describe the informative package of information the Operator provide to their crewmembers which includes the operational flight plan and the weather enroute.

² When asked about the turbulence on the route, he stated that flying over Indian Ocean mostly include active weather conditions such as Cumunulimbus formation and turbulence activity.

³ A waypoint is a specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation [Source: www.skybrary.com]



About seven hours into the flight, at 2105:03 UTC, and while flying in Male's FIR, the Aircraft encountered a severe turbulence, causing serious injuries and damage to the cabin interiors. The Aircraft exited Male's FIR at 2145:50 UTC.

As per the Commander's statement, after consulting the flight crew and the cabin supervisor, and considering the diagnosis of the doctors who were onboard, he decided to proceed with the flight to OMDB. As per the augmenting captain statement, a medical emergency was declared over Dubai airspace on radio telephony (RT).

At 0045:02 UTC, the Aircraft landed safely at OMDB.

1.2 Injuries to Persons

Table 1. Injuries to persons						
Injuries	Flight crew	Cabin crew	Other crew onboard	Passengers	Total Onboard	Others
Fatal	0	0	0	0	0	0
Serious	0	2	0	3	5	0
Minor	0	12	0	11	23	0
None	3	10	0	449	462	0
TOTAL	3	24	0	463	490	0

1.3 Damage to Aircraft

The Aircraft sustained damage to the cabin. This has resulted in the Aircraft going under maintenance after arrival at OMDB. Further maintenance actions will be discussed in the Final Report.

1.4 Other Damage

There was no other damage.

1.5 Personnel Information

Table 2 illustrates the Commander and Copilot information current at the time of the Accident.

Table 2. Crew information		
	Commander	Copilot
Age	47	39
Type of license	ATPL (A)	ATPL (A)
Valid to	9 August 2024	27 October 2027
Rating	IR/MPA/A330/A340/A380	IR/MPA/A380
Total flying time (hours)	13,438.33	6,432.55
Total on this type (hours)	9,216.99	1,515.55
Total on type last 90 days (hours)	257.46	230.27
Total on type last 7 days (hours)	35.30	38.36
Total last 24 hours (hours)	10.39	10.39
Last recurrent SEP training	9 November 2023	17 October 2023



Last Operational Proficiency Check (OPC)	21 March 2023	25 December 2023
Last line check	16 December 2022	25 August 2023
Medical class	Class 1	Class 1
Valid to	30 June 2024	7 June 2024
Medical limitation	Nil	Nil

1.6 Aircraft Information

The Airbus A380 is a four-engine jetliner manufactured by Airbus Industries. The Aircraft cabin layout is comprised of “double -deck”. The Operator is the largest operator of this type of aircraft.

1.6.1 Aircraft data

Table 3 illustrates the general Aircraft information as of the date of the Incident

Table 3. Aircraft data	
Manufacturer:	Airbus Industries
Model:	A380-861
MSN:	150
Date of manufacture:	TBD
Nationality and registration:	A6-EEV
Name of the Operator:	Emirates Airlines
Certificate of airworthiness	
Number:	UAE-COA-0230
Issue date:	19 May 2014
Certificate of registration	
Number:	UAE-COR-0724
Issue date:	19 May 2014
Date of delivery	19 May 2014
Time since new (TSN) (hours)	37,845:43
Cycles since new (CSN)	4,133
Cycles since last service check	26

1.6.2 Airbus A380 weather radar modes

As per the *flight crew operating manual (FCOM)*, the weather radar system (WXR) has the following modes:

- weather (WX) display function
- turbulence (TURB) detection function
- weather ahead function
- predictive wind shear system (PWS) function
- ground mapping function.



The weather radar is armed on ground when the WXR button has been set to AUTO on the multi-functional display (MFD) page. When armed, the WXR will start to scan the envelope ahead of the aircraft if both of the following conditions are met (Figures 1 and 2):

- At least one engine is running; and
- The WX pushbutton is selected on at least one electronic flight instrument system (EFIS) control panel (CP).



Figure 1. Weather radar rotating knobs
[Source: FCOM-Surveillance Panel]



Figure 2. WX (weather) button on EFIS

1.7 Meteorological Information

The Investigation examined the weather information provided to the flight crew on the day of the Accident⁴. The forecast for the flight segment over Male FIR indicated the presence of **Cumulonimbus** (CB) cells which were expected to be associated with moderate/severe turbulence and with icing. Additionally, the eastern part of India was impacted by the active cyclone "Michaung," leading to heavy rainfall and flooding⁵.

⁴ The weather information was provided by world area forecast centers (WAFC). One is located in the United States of America and operated by National Oceanic and Atmospheric Administration (NOAA) and the other one is located in the United Kingdom and operated by the Meteorology Office. The information provided to the Operator was from the center located in the United Kingdom. [Source: <https://www.metoffice.gov.uk>]

⁵ The rain dropped 20 centimeters of rain in many areas of Eastern coast of India [Source: <https://earthobservatory.nasa.gov>]

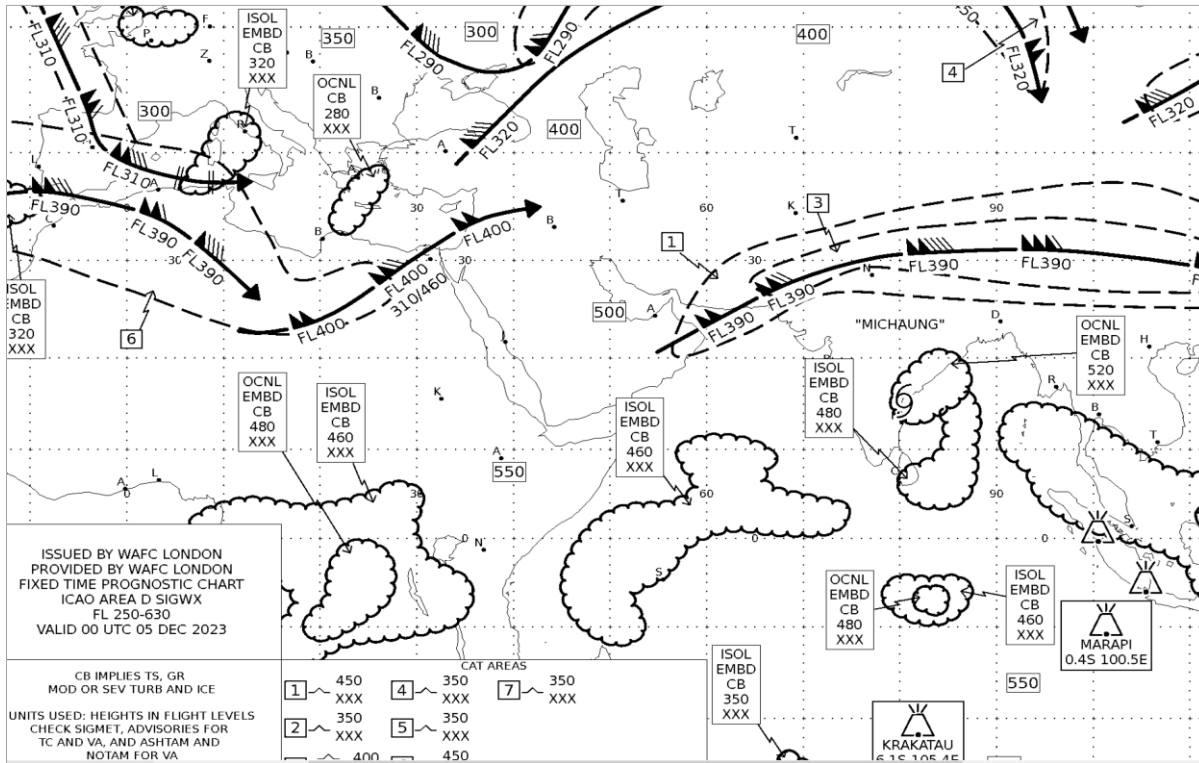


Figure 3. Weather information forecasting CB formation over and around Male's FIR which was provided to the flight crew

The Commander and augmenting captain stated that they took note of the CB formation at their 10 to 11 o'clock position. In addition, the augmenting captain stated, "there was a layer of clouds that is significantly under the aircraft."

Further weather details will be discussed in the Final Report.

1.8 Aids to Navigation

Aids to navigation will be discussed in detail in the Final Report.

1.9 Communications

All communications between air traffic control and the flight crew were recorded by the ground-based voice recording equipment and made available to the Investigation.

Entering Male FIR, and as per the Commander's and the augmenting captain's statements, the communication was done by means of controller pilot data link communications (CPDLC).

The details of the communication will be further discussed in the Final Report.

1.10 Aerodrome Information

The Accident occurred in-flight.

1.11 Flight Recorders

The Aircraft was equipped with a digital flight data recorder (DFDR) and a cockpit voice recorder (CVR) unit as mentioned in table 4.



Table 4. Flight data recorder

Recorder	Manufacturer	Model	Serial Number	Date Received	Date Downloaded
DFDR	L3-Comms	2100-4045-00	000905076	7 December 2023	11 December 2023
CVR	L3-Comms	2100-1025-02	000596336	7 December 2023	11 December 2023

The DFDR was received in good condition and the downloaded data was relevant to the flight. The data retrieved from the DFDR will be analysed and discussed in the Final Report.

The Investigation downloaded the compressed audio file from the CVR. The download file was decompressed and converted into five readable audio files which will be analyzed and discussed in detail in the Final Report.

1.12 Wreckage and Impact Information

The Aircraft was intact.

1.13 Medical and Pathological Information

The flight crew did not undergo any medical test post-Accident.

1.14 Fire

There were no signs of fire.

1.15 Survival Aspects

Will be discussed in the Final Report

1.16 Tests and Research

Will be discussed in the Final Report.

1.17 Organizational and Management Information

Will be discussed in the Final Report.

1.18 Additional Information

Additional Information will be discussed in the Final Report.

1.18.1 Operation manual – Part A (OM-A) policies – [Operating] in Adverse and Potentially Hazardous Atmospheric Conditions

As per the OM-A – Operating in Adverse and Potentially Hazardous Atmospheric Conditions, flights should not be dispatched or operated into or through areas of reported or forecast hazardous weather conditions.

1.18.2 Flight crew techniques manual (FCTM) – Use of Weather Radar

As per the FCTM – Use of Weather Radar – General Modes, both PF and PM can independently manage their own weather radar display.

It also states,

“... By default, TURB (turbulence) mode should be in AUTO. The flight crew can temporarily turn off the TURB mode to better differentiate between precipitations and wet turbulence.”



In addition, it states,

“... at a long distance, ahead of the aircraft the accuracy of the weather echo is low due to the both of the following:

- The increase of width in the weather radar beam
- Signal attenuation ...”

Further discussion to the use of weather radar will be discussed in the Final Report.

1.18.3 Quick reference handbook (QRH) – Procedures during severe turbulence⁶

As per the QRH – *Abnormal Procedures – Severe Turbulence*, the following procedures need to be implemented by the flight crew:

“... ”

- Seat belts: ON
- Maximum turbulence speed: 300kts/.85 Mach
- Minimum turbulence speed: Green Dot⁷

Adjust speed as necessary for comfort.

- Autopilot: Keep ON
- Cabin and cockpit (loose equipment): Secure

The flight and cabin crewmembers must secure all loose equipment.

Be prepared to use the speed brake, if necessary.

If excessive thrust variations:

- Auto Thrust: OFF
- Descend to or below optimum altitude: Consider...”

1.19 Useful or Effective Investigation Techniques

The techniques employed during this Investigation will be outlined in detail in the Final Report.

⁶ Severe turbulence is characterized by large, abrupt changes in attitude and altitude with large variations in airspeed. There may be brief periods where effective control of the aircraft is impossible. Loose objects may move around the cabin and damage to aircraft structures may occur. [Source: www.skybrary.com]

⁷ Green Dot Speed is defined as: the engine-out operating speed in clean configuration. It provides an estimate of the speed for best lift-to-drag ratio. [source: www.skybrary.com]



2. Ongoing Investigation Activities

The Investigation is ongoing and will include further examination and analysis of:

- The implementation of dispatch policy as outlined in the *OM-A*
- Human factors including training
- Organizational factors
- The procedural aspects
- Any other safety aspects that may arise during the course of this Investigation.

This Preliminary Report is issued by:

**The Air Accident Investigation Sector
The United Arab Emirates.**

E-mail: aai@gcaa.gov.ae