FINAL INVESTIGATION REPORT

ACCIDENT OF ETIHAD AIRWAYS FLIGHT ETD-72K, B787-900 AIRCRAFT, REG. NO. A6-BLF AT ALLAMA IQBAL INTERNATIONAL AIRPORT, LAHORE ON 27 MAY, 2022

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SCOPE

At Bureau of Aircraft Safety Investigation Pakistan (BASIP) investigations are conducted in accordance with Pakistan Aircraft Safety Investigation (PASI) Act, 2023 and International Civil Aviation Organization (ICAO) Annex-13.

The sole objective of the investigation and its final report as per above stated regulations is to prevent future accidents / serious incidents / incidents of similar nature without apportion blame or liability. Accordingly, it is inappropriate to use BASIP investigation reports to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for Judiciary and administrative purpose.

This report contains facts, which are based on information which came to the knowledge of BASIP during the investigation up to the time of publication. Such information is published to inform the aviation industry and the public about the general circumstances of civil aviation accidents and incidents.

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ABBREVATIONS

ACC	Area Control Centre
AGL	Above Ground Level
AIIAP	Allama Iqbal International Airport
AP	Auto Pilot
ATIS	Automatic Terminal Information System
ATPL-A	Airline Transport Pilot License - Aircraft
BASIP	Bureau of Aircraft Safety Investigations Pakistan
CB	Cumulonimbus
DFDR	Digital Flight Data Recorder
FL	Flight Level
FO	First Officer
G	Acceleration due to gravity
GCAA	General Civil Aviation Authority
h	Hour(s)
HDG	Heading
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IOU	Incident Occurrence Unserviceability
kt	Knot(s)
m	Meter(s)
METAR	Meteorological Aerodrome Report
MLA	Manoeuvre Load Alleviation
NM	Nautical Mile(s)
OPLA	Lahore Airport
PA	Public Announcement
R/W	Runway
s	Second(s)
Sig MET	Significant Meteorological Information
TOD	Top of Descent
UAE	United Arab Emirates
UTC	Universal Time Coordinated
VNAV	Vertical Navigation

INTRODUCTION

The accident was reported to Bureau of Aircraft Safety Investigation Pakistan (BASIP) through daily Incident and Occurrence Unserviceability (IOU) Report[1] and subsequently through an email from General Civil Aviation Authority (GCAA), United Arab Emirates (UAE)[2]. Initial notification of the accident was sent to International Civil Aviation Organization (ICAO)[3] on 16 June, 2022. All corresponding timings are mentioned in Universal Time Coordinated (UTC).

[1] PCAA – IOU Report dated 28 May, 2022
[2] GCAA - E-mail dated 28 May, 2022
[3] BASIP- Notification sent to ICAO, NTSB, GCAA

SYNOPSIS

On 27 May, 2022, Etihad Airways Flight ETD-72K, B787-900 aircraft, Reg. No. A6-BLF was operating from Abu Dhabi International Airport, Abu Dhabi – UAE to Allama Iqbal International Airport (AIIAP), Lahore – Pakistan as a scheduled passenger flight with 128 persons (115 passengers & 13 crew) onboard. When the aircraft was 27 Nautical Miles (NM) from touchdown Runway (R/W) 36L, the Flight Crew transmitted for requirement of medical assistance on arrival as one of the Cabin Crew had sustained injuries due to enroute turbulence. After the aircraft had parked, it was learnt that a total of three (03) passengers and eight (08) Cabin Crew had sustained injuries due to the turbulence. One (01) Cabin Crew had to be admitted in the hospital whereas the rest of the persons were cleared after First Aid. Due to the nature of the injuries sustained by the Cabin Crew, the occurrence has been classified as an accident.

SECTION 1 – FACTUAL INFORMATION

1.1. History of the flight

1.1.1. On On 27 May, 2022 Etihad Airways Flight ETD-72K B787-900 aircraft, Reg. No. A6-BLF was a scheduled passenger flight from Abu Dhabi International Airport, Abu Dhabi UAE to AIIAP, Lahore Pakistan. Ground operations were normal and ETD-72K got airborne at 191800.

1.1.2. The flight remained uneventful till the time the aircraft approached AIIAP, Lahore. The aircraft came into contact with Area Control Centre (ACC) East at 212729.

1.1.3. The landing briefing was conducted amongst the Flight Crew prior to Top of Descent (TOD) point. ETD-72K was number one in sequence with no other traffic ahead.

1.1.4. The weather had been updated approximately 90 minutes (min) before landing on the WAS (Weather Awareness Solution) which showed a Cumulonimbus (CB) clouds 30-40 NM North of the Airport. The Automatic Terminal Information Service (ATIS) also indicated “Wind 320 degrees (º) 14 knots (kt), visibility 4,000 meters (m), Haze Temporary Wind 320º 20 kt gusting 45 kt, Visibility 800 m, Dust Thunderstorm Rain”.

1.1.5. During initial descent, the weather radar showed an active weather cell approximately 80 NM ahead which was also visible to the Flight Crew due to lightning taking place. Due to the weather, the Flight Crew decided to deviate 20 NM to the East of the planned route.

1.1.6. At 214018, once the aircraft was at a distance of 40 NM from the weather cell, the Flight Crew requested for heading (HDG) 060º which was approved. At this time the aircraft was crossing Flight Level (FL) 200 at a speed of 290 kt. As the aircraft turned onto HDG 060º, the aircraft entered clouds and was immediately hit by a updraft which also disconnected the Auto Pilot (AP). At this time the aircraft was 65 NM from AIIAP, Lahore. The updraft was followed by severe turbulence which lasted for approximately 10 seconds (s) and caused the engine anti-ice as well as wing anti-ice system to come on automatically. The Flight Crew made the announcement on the Public Announcement (PA) system for the Cabin Crew to be seated and re-engaged the AP. During all this time the weather radar only showed the active weather cell 35 NM ahead of the aircraft with no other weather activity in close vicinity.

1.1.7. At this time, the aircraft was in clouds due to which the Flight Crew requested further right HDG to 090º at 214129 and then HDG 100º at 214142, but it was not cleared.

1.1.8. 214150. The Flight Crew again requested for HDG 090º for 25 NM in response to which they were cleared to turn onto HDG 080º.

1.1.9. 214219. The Flight Crew again requested for HDG 090º for 20 NM which was approved. Once the aircraft was stabilized the Captain inquired from the Cabin Crew regarding the situation and was informed that two (02) Cabin Crew along with some passengers were injured. At the moment the aircraft was descending through FL 110 and the Captain asked the Cabin Crew to secure the passengers for landing.

1.1.10. 214423. Aircraft turned back onto HDG 060º and was cleared to descend to 4,000 feet (ft) at a distance of 50 NM from touchdown.

1.1.11. 214617. The aircraft changed over to Approach Control for their final approach for landing.

1.1.12. 214953. The Flight Crew informed Approach Control that they had one (01) Cabin Crew who was injured due severe turbulence encountered.

1.1.13. After landing, once the aircraft was parked, it was learnt that a total of three (03) passengers and eight (08) Cabin Crew had sustained injuries of varying nature. The medical personnel attended to the injured passengers and Cabin Crew out of whom one (01) Cabin Crew had to be admitted to the hospital while the others were cleared after administrating First Aid.

1.2. Injuries to person(s)

1.2.1. The details of the injuries sustained by the Cabin Crew and passengers are as follows: -

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	-	-	-	-
Serious	1	-	1	-
Minor	7	3	10	-
None	5	112	117	-
TOTAL	**13**	**115**	**128**	**-**

Table 1 Injuries to Person(s)

1.2.2. The details of the injuries sustained are as follows : -

Designation	Injury	Treatment
Cabin Crew# 1	• Pain in left pelvic region • Unable to walk	• Shifted to hospital • Retained at hospital due fractured pelvis • Patient wanted treatment at Doha (Qatar), therefore discharged from hospital • Further treatment out of country
Cabin Crew# 2	• Pain in left shoulder, neck, left knee joint	• Shifted to hospital • Discharged after treatment • Advised to wear cervical collar • Further treatment out of country
Cabin Crew# 3	• Pain in neck, shoulders, left hip, left thigh	• Shifted to hospital • Discharged after treatment • Further treatment out of country
Cabin Crew# 4	• Pain in right foot	• Shifted to hospital • Discharged after treatment • Further treatment out of country

Cabin Crew# 5	• Pain in left upper limb, left lower limb, left side of head	• Treatment out of country
Cabin Crew# 6	• Pain in lower back	• Treatment out of country
Cabin Crew# 7	• Mild spasm in left upper arm • Mild spasm in right lower back	• Treatment out of country
Cabin Crew# 8	• Pain in left shoulder • Pain in back	• Treatment out of country
Passenger# 1	• Whiplash injury	• Treated at hospital and discharged
Passenger# 2	• Backache	• First aid administered
Passenger# 3	• Pain in right shoulder	• First aid administered

Table 2 Details to Injuries

1.3. Damage to aircraft

1.3.1. Dent in 01 overhead stowage bin.

1.3.2. 01 lavatory ceiling panel damaged.

1.3.3. 02 dents and delamination on aft galley left hand ceiling panel.

1.4. Personnel information

Captain	
Date of Birth	27 January, 1984
Date of Joining Etihad Airways	7 September, 2009
License type	ATPL-A (Airline Transport Pilot License - Aircraft)
Medical Status	Class 1 valid
Type Rating	A320 / A330 / B777 / B787
Type Current	B787
Flying Experience	4806 h
Grand Total	10024 h
Total in Command	7270 h
Total in Command on Type	4738

Table 3 Captain's Brief Description

First Officer (FO)	
Date of Birth	16 August, 1973
Date of Joining Etihad Airways	1 December, 2014
License type	ATPL-A
Medical Status	Class 1 valid
Type Rating	B777 / B787
Type Current	B777 / B787
Flying Experience	6086 h
Grand Total	6086 h
Total in Command	-
Total in Command on Type	-

Table 4 First Officer's Brief Description

1.5. Aircraft Information

Aircraft Details	
Call Sign	ETD-72K
Aircraft Make & Model	B787-9
Registration Marking	A6-BLF
Year of Manufacture	2016
Manufacturer Serial No.	39651
Operator	Etihad Airways
Hours Flown	26022:49

Table 5 Aircraft Details

Aircraft Details		
	Engine No 1	**Engine No 2**
Engine Serial No	958358	956752
Manufacturer	GE	GE
Engine Type	GENX1B74-75P2G01	GENX1B74-75P2G01
Total Hours Flown	8577:07	20149:58
Date of Installation	20 February, 2022	29 June, 2020
Hours Since Installation	881:39	7024:35

Table 6 Engine Details

1.6. Meteorological information

1.6.1. At the time of the incident, the weather as reported by ATIS is as follows: -

Weather Report	
Station:	OPLA
Wind direction:	320°
Wind speed:	14 kt
Visibility	4,000 m
Sky condition:	Haze
Temperature:	14°

Table 7 Weather Report by ATIS

1.6.2. At the time of occurrence, a CB cloud was present 30-40 NM north of AIIAP, Lahore. At 212000 weather information was fed in ATIS whereas, the occurrence took place at 214000. Moreover, the information was not shared with Flight Crew by ATC Lahore[4]. The weather warning was valid till 003000 on 28 May which was as follows: -

1.6.2.1. Dust Thunderstorm rain likely to occur

1.6.2.2. Surface wind from North West may gust to 55 kt

1.6.2.3. Surface visibility may reduce to 800 m due raised dust

1.6.2.4. Moderate / Severe turbulence may occur in Few CB at 3,000 ft Above Ground Level (AGL).

1.7. Aids to navigation

1.7.1. At the time of the incident no abnormality was reported for the airfield. Navigational aids for AIIAP, Lahore are as follows: -

TYPE OF AID	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
ILS/LOC CAT I 36L	ILO	109.7 MHz	H24	313223.67N 0742410.54E	NIL	NIL
ILS/LOC CAT III 36R	ILA	109.9 MHz	H24	313224.49N 0742417.66E	NIL	Coverage 20 NM
NDB	LA	268.0 kHz	H24	313123.41N 0742348.18E	NIL	NIL
DVOR/DME (2°E/2020)	LA	112.7 MHz CH74X	H24	313109.66N 0742400.05E	227.07M	200NM
MM	-	75.0 MHz	H24	312949.99N 0742414.91E	NIL	RWY 36R
OM	LO	338.0 kHz	H24	312641.15N 0742404.47E	NIL	Locator Outermarker RWY 36R
OM	-	75.0 MHz	H24	312641.50N 0742404.51E	NIL	RWY 36R
GP/TDME 36L	ILO	333.2 MHz CH34X	H24	313042.70N 0742403.86E	235.31M	NIL
GP/TDME 36R	ILA	333.8 MHz CH36X	H24	313033.31N 0742412.15E	231.04M	Coverage 7-10 NM

Table 8 Aids to Navigation AIIAP, Lahore

[4] MET Report

1.8. Communications

1.8.1. No abnormality was reported at the time of the incident. Communication frequencies for AIIAP are as follows: -

Service designation	Call sign	Frequency	Hours of operation	Remarks
1	2	3	4	5
APP	Lahore APP	121.300 MHz	H24	Primary
APP	Lahore APP	121.500 MHz	H24	Emergency
APP	Lahore APP	125.300 MHz	H24	Secondary
ATIS	ATIS	126.300 MHz	H24	Nil
BS	Radio Pakistan	630.000 KHz	HX	0130 – 1900 HR
BS	Radio Pakistan	1090.000 KHz	HX	Variable SKED
GCA	Lahore Ground	118.400 MHz	H24	Primary
GCA	Lahore Ground	121.800 MHz	H24	Secondary
TWR	Lahore Tower	118.100 MHz	H24	Primary
TWR	Lahore Tower	118.875 MHz	H24	Secondary

Table 9 Communication Facilities AIIAP, Lahore

1.9. Aerodrome information

1.9.1. No abnormality was reported at the time of the incident. AIIAP, Lahore aerodrome data is as follows: -

Designations RWY NR	True bearing	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY	Slope of RWY/SWY
1	2	3	4	5	6	7
18L	180.00°	3360 x 46	85/R/B/X/U Concrete	313211.94N 0742417.44E	THR 216.90 M / 711.61 FT	0.050%
36R	360.00°	3360 x 46	85/R/B/X/U Concrete	313023.30N 0742415.49E	THR 215.10 M / 705.71 FT	-
18R	180.88°	2743 x 46	69/F/C/X/U ASPH	313202.10N 0742410.19E	THR 216.50 M / 710.30 FT	0.050%
36L	0.88°	2743 x 46	69/F/C/X/U ASPH	313033.10N 0742408.60E	THR 214.80 M / 704.72 FT	-

SWY dimension (M)	CWY dimension (M)	Strip dimension (M)	RESA dimension (M)	Arresting system	Obstacle Free Zone	Remarks
8	9	10	11	12	13	14
122	305-	3724 x 300	-122 x 90	-	Available	-
122	305	3724 x 300	122 x 90	-		-
244	244-	3381 x 300	-92 x 90	-	Available	-
274	274	3381 x 300	92 x 90	-		-

Table 10 Runway Physical Characteristics AIIAP, Lahore

1.10. Flight recorders

1.10.1. Digital Flight Data Recorder (DFDR) was analysed to observe the sequence of events[5] and to ascertain the cause of the accident. Aircraft DFDR data shows that

1.10.1.1. The aircraft initially encountered a significant updraft that dissipated after 6-7 s.

1.10.1.2. The largest load factor excursions occurred at the initial onset of the updraft and its dissipation.

1.10.1.3. Maximum load factor was 1.8 Gs while minimum was -0.75 Gs.

1.10.1.4. The AP disconnected at approximately the same time as the dissipation of the updraft upon a sharp control input by the Flight Crew due to overriding force. AP was reengaged after approximately 30 s of initial updraft onset.

1.10.1.5. During manual aircraft control, the Flight Crew inputs did not serve to exacerbate the acceleration excursions.

1.11. Medical and pathological information

1.11.1. Medical samples for pathological investigations of the Flight Crew were not collected.

1.12. Fire

1.12.1. There was no fire reported in the incident.

1.13. Organizational and Management Information

1.13.1. **Availability of ambulances** – The incident encountered by ETD-72K resulted in injuries to both Cabin Crew as well as passengers. While only one person had injuries serious enough to warrant admission to a hospital, the others also required various degrees of treatment. Some had to be transported to a hospital as well for treatment while others were just administered first aid. The presence of several injured people onboard a single aircraft necessitated **the need for multiple ambulances to attend to the injured personnel**. However, despite numerous requests for more ambulances to be made available, only one ambulance was provided for management of the situation. When inquired about the second ambulance, it was told that the ambulance was parked outside the airport; however, the driver for the second ambulance was not available due to which it could not be utilized. While the situation was handled amicably, it was only because the number of people requiring transportation to the hospital was less. In case the number of injured people had been more, especially with injuries necessitating the mandatory use of ambulances for transportation to a hospital, the situation would have been difficult to handle.

[5] Etihad Airways - DFDR Data

1.14. Useful or effective investigation techniques

1.14.1. Standard investigation procedures and techniques were used.

SECTION 2 - ANALYSIS

2.1. General

2.1.1. On May 27, 2022, Etihad Airways Flight ETD-72K, operated by a Boeing 787-9 Dreamliner (Registration: A6-BLF), was a scheduled passenger flight which operated from Abu Dhabi International Airport, UAE, to Allama Iqbal International Airport (AIIAP), Lahore, Pakistan. Ground operations were normal and ETD-72K got airborne at 191800. The flight remained uneventful till the time it approached AIIAP, Lahore for landing.

2.1.2. Approximately 27 NM from landing on Runway 36L at Lahore, the flight crew requested medical assistance on arrival due to a medical emergency: One (01) cabin crew member had sustained injuries during severe enroute turbulence.

2.2. Approach

2.2.1. ETD-72K came into contact with Area Radar Controller East at time 212700 around position MIMAL maintaining FL 390. At this time Lahore was reporting weather as “Weather warning for Dust Thunderstorm Rain from 213000 to 003000 (28 May). Surface wind from north west may gust up to 55 kt. Surface visibility may reduce to 800 m. Raised dust precipitation, medium / severe turbulence may occur in few CB at 3,000 ft AGL”. This weather information had already been fed in the ATIS at 212000. However, information was not shared with Flight Crew by ATC. ETD-72K was cleared for Standard Instrument Arrival (STAR) MML1A for Instrument Landing System (ILS) “Z” Approach for R/W 36L and was cleared for descent to FL 70 at time 212800.

2.2.2. The Flight Crew had last updated the weather on WAS approximately 90 min ago which showed a CB north of AIIAP, Lahore by about 30-40 NM. The landing briefing was conducted by the Flight Crew well before TOD and descent was commenced as per the clearance obtained. Both the Flight Crew had Weather Radar selected on display which showed a CB cell about 80 NM ahead at this time which was also visible because of the lightning.

2.3. Effects of turbulence

2.3.1. Due to the weather, the Flight Crew decided to deviate 20 NM to the east of the planned route. At 214018, once the aircraft was at a distance of 40 NM from the weather cell, the Flight Crew requested to turn onto HDG 060º which was approved by the controller. At this time the aircraft was crossing FL 200 at a speed of 290 kt. As the aircraft turned onto HDG 060º, the aircraft entered clouds and was immediately hit by a updraft which also disconnected the Auto Pilot (AP). The aircraft encountered a strong updraft lasting 6–7 seconds, followed by continued turbulence for 3–4 minutes.

2.3.2. The distance of the aircraft at this time was 65 NM from Lahore. The updraft was followed by severe turbulence which dissipated after 6-7 s; however, it caused the engine anti-ice as well as wing anti-ice system to come on automatically. The Flight Crew made the announcement on the PA system for the Cabin Crew to be seated, however, seatbelt signs had been turned on passing FL260, approximately four (4) min prior to the turbulence event and re-engaged the AP. During all this while, the weather radar showed only the active weather cell 35 NM ahead of the aircraft with no other weather activity in close vicinity.

2.3.3. Analysis of DFDR data reveals that the aircraft was subject to the highest load factor at the initial onset of the updraft and during its dissipation. The aircraft was subjected to maximum load factor of +ve 1.8 Gs and a minimum of -ve 0.75 Gs. While positive Gs caused a strain on the airframe and the passengers, the negative G force resulted in the Cabin Crew as well as the passengers to strike against the aircraft fuselage inside the cabin, ensuing in injuries. The Cabin Crew at this time were engaged in service inside the cabin and were not seated or strapped up, which resulted in them striking against the aircraft more severely thereby resulting in injuries of a graver nature.

2.3.4. When the turbulence hit the aircraft, the Flight Crew commanded a sharp left control wheel input which resulted in AP disconnection due to control wheel override force of 26-31 pounds. The aircraft continued under manual control for 30 s during which time there was no exceedance of flight parameters. The AP was subsequently reengaged.

2.3.5. Throughout this episode, the Maneuver Load Alleviation (MLA) remained activated resulting in symmetric aileron and spoiler deflection. The aircraft is also equipped with Vertical Gust Suppression (VGS) which commands symmetric flaperon deflection; however, it is only active above 30,000 ft pressure altitude with the autopilot engaged in either Altitude Hold or Vertical Navigation (VNAV) while in level flight.

2.3.6. The attached plots contain a set of 6 figures retrieved from FDR, showing the longitudinal and lateral-directional parameters with different time scales (progressively zooming in) provided below: -

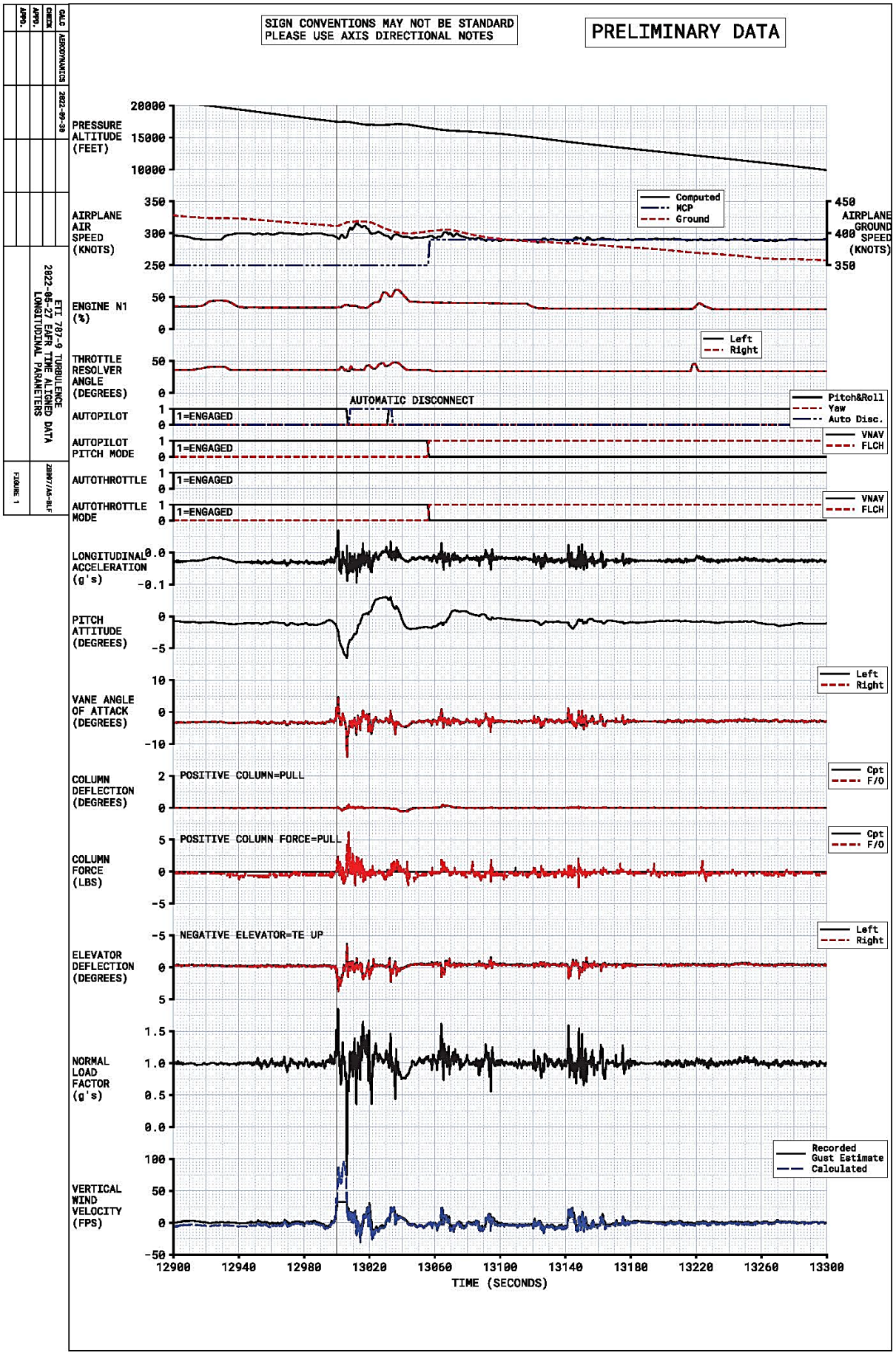


Figure 1 Directional Parameters 1/6

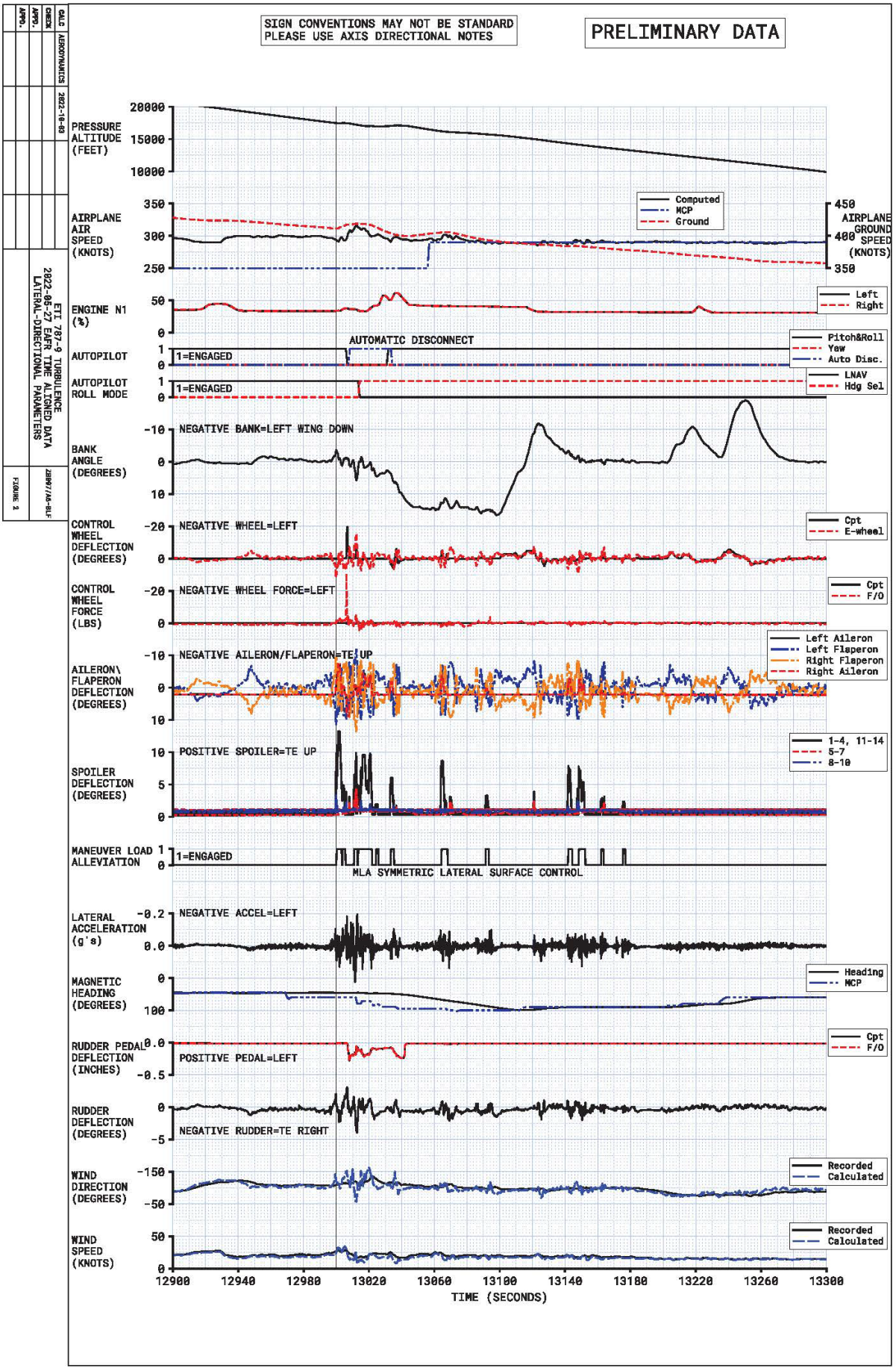


Figure 2 Directional Parameters 2/6

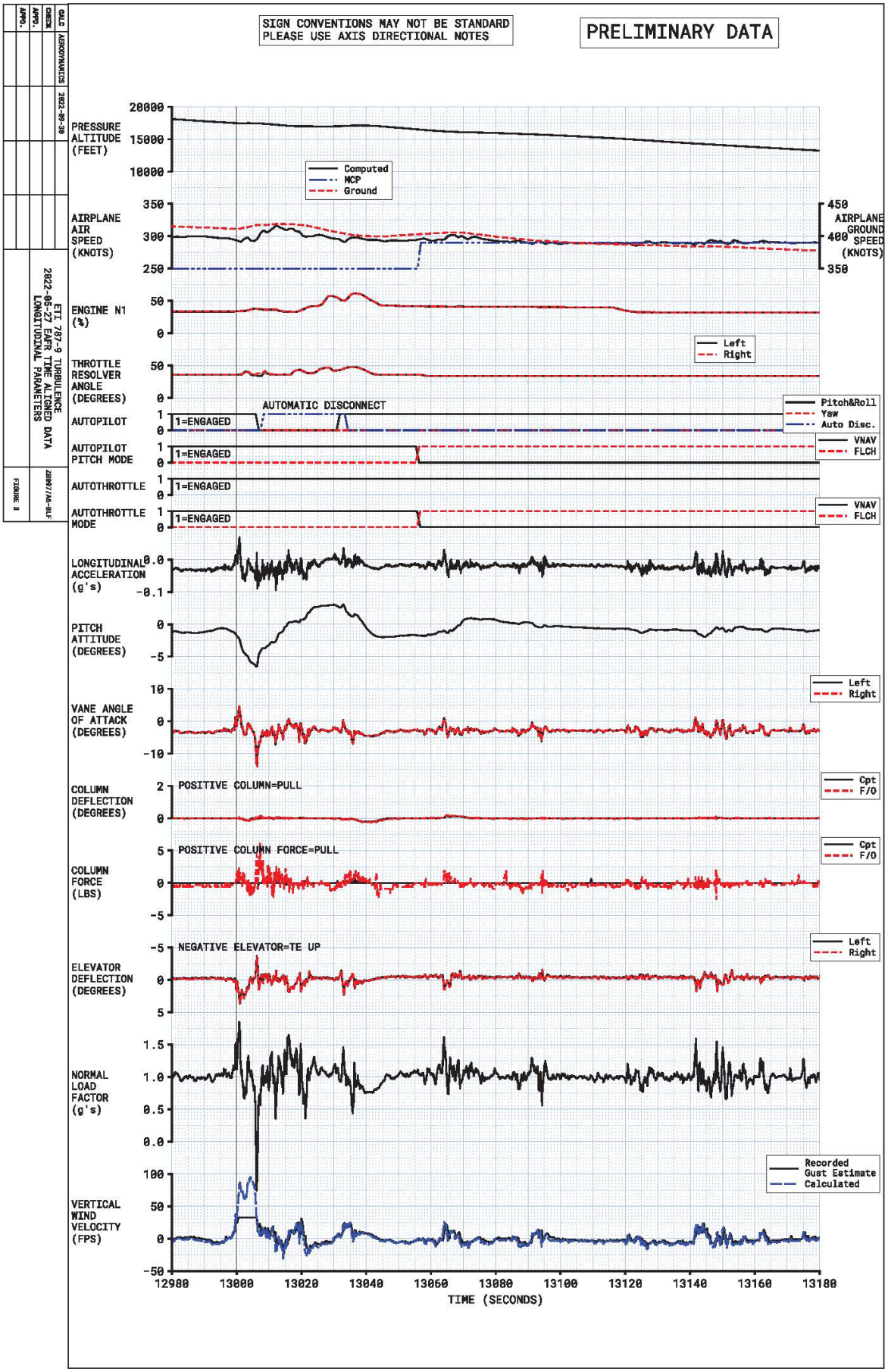


Figure 3 Directional Parameters 3/6

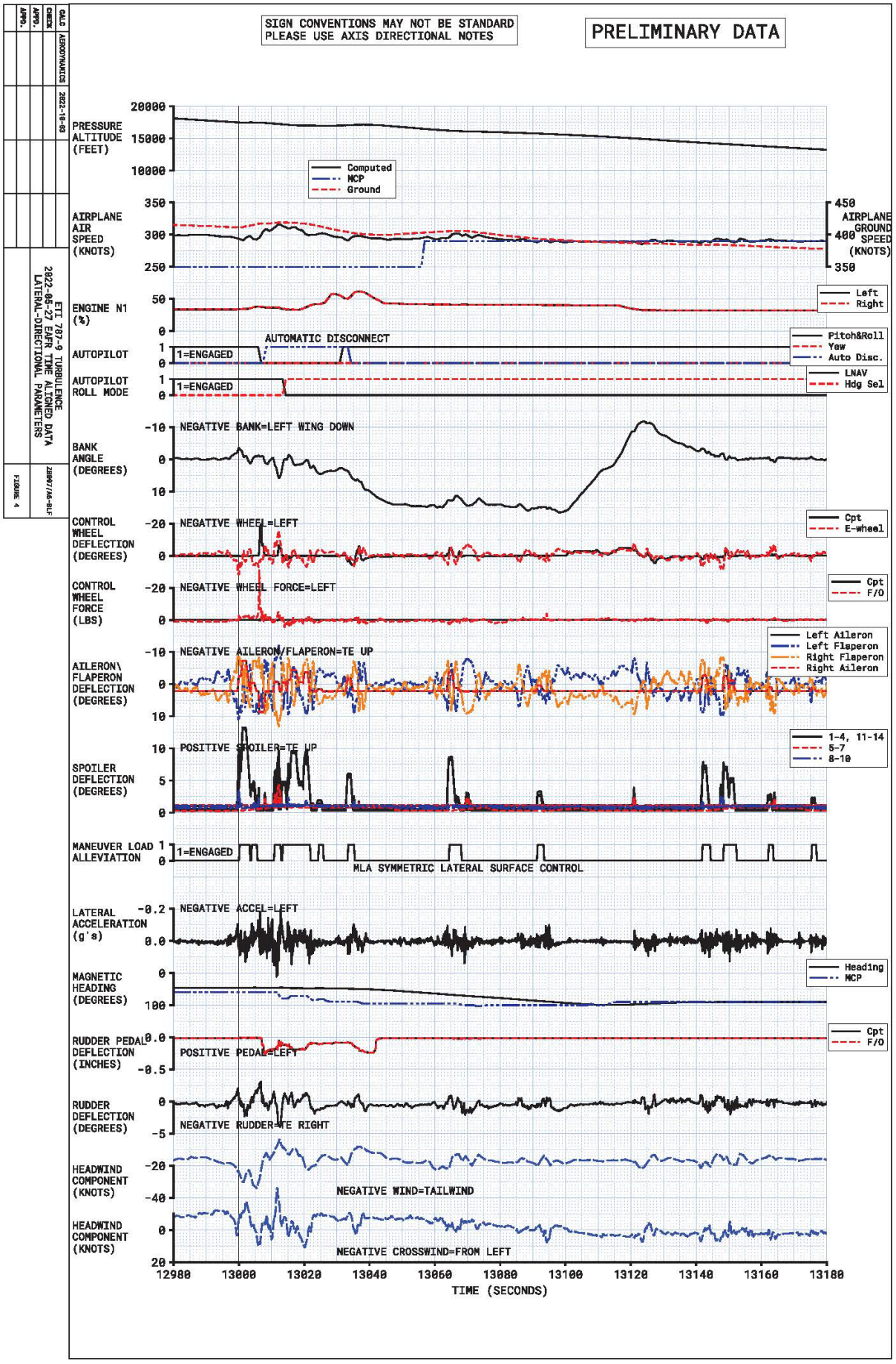


Figure 4 Directional Parameters 4/6

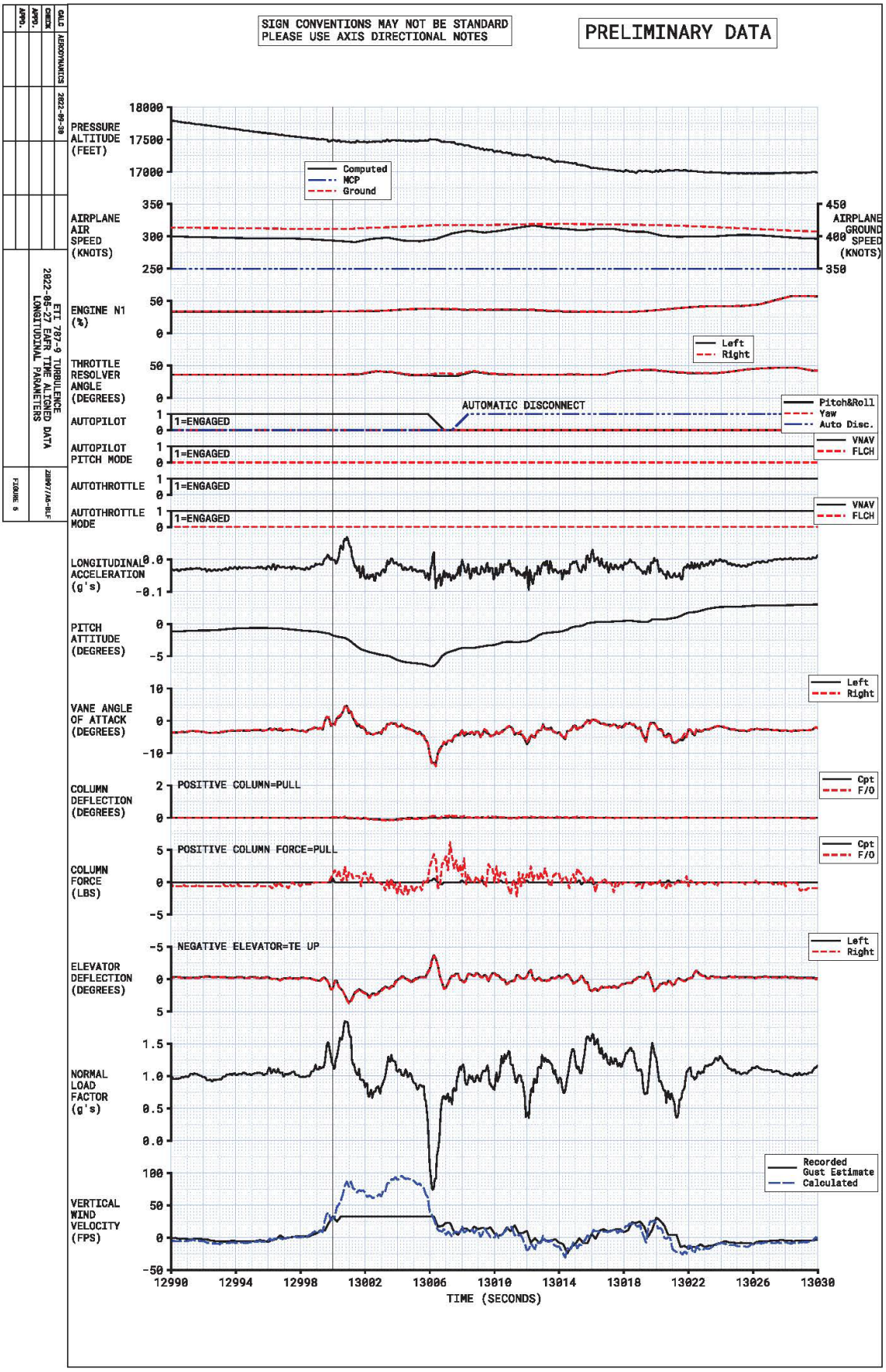


Figure 5 Directional Parameters 5/6

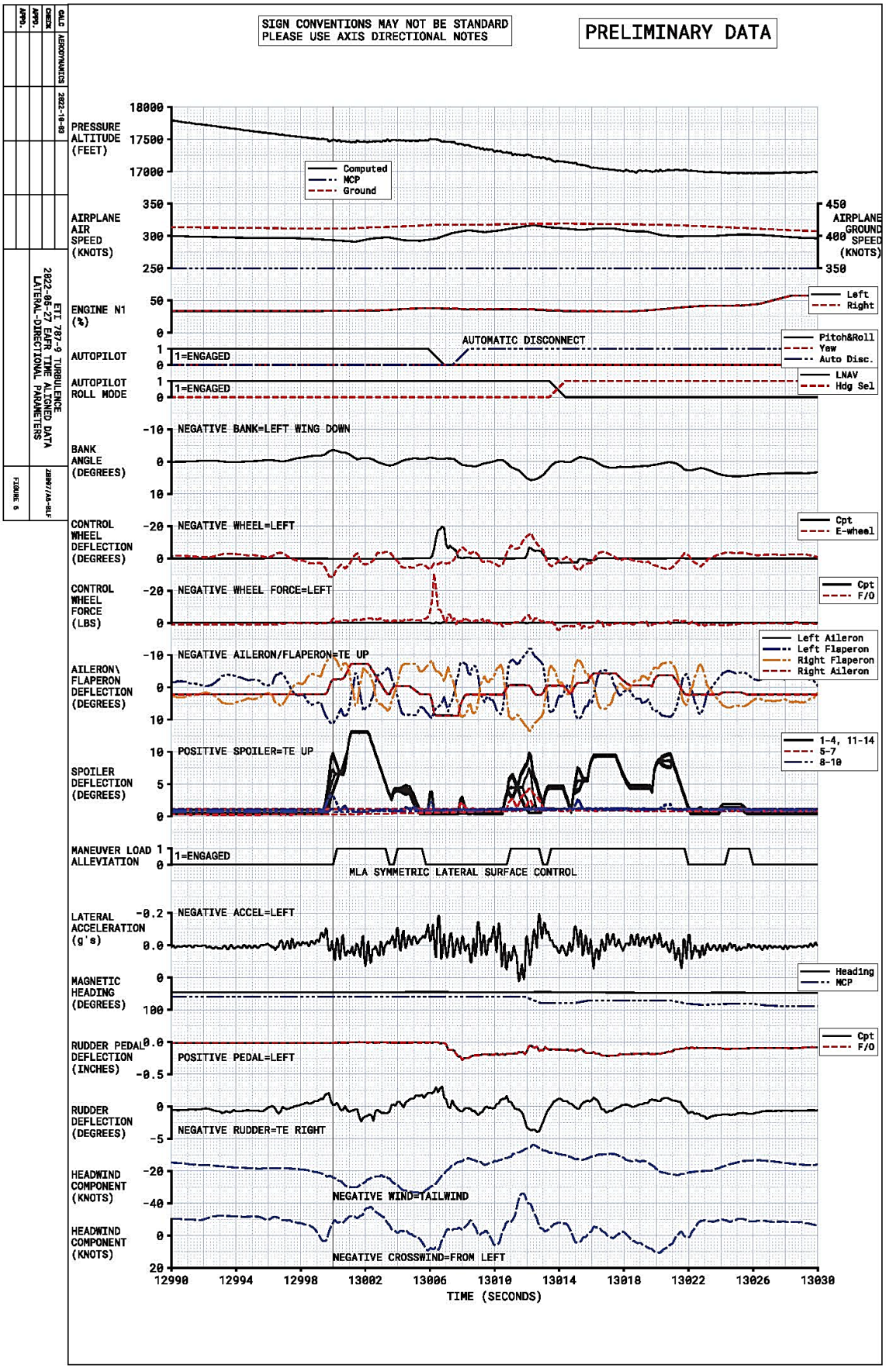


Figure 6 Directional Parameters 6/6

2.4. Meteorological analysis

2.4.1. **METAR for Lahore**. Detailed METAR for Lahore is as follows: -

OPLA,2022-05-27 19:55, OPLA 271955Z 12004KT 4000 HZ SCT040 31/19 Q0996 NOSIG RMK QFE969 A29.44
OPLA,2022-05-27 20:25, OPLA 272025Z 10006KT 4000 HZ SCT040 31/19 Q0996 NOSIG RMK QFE969 A29.43
OPLA,2022-05-27 20:55, OPLA 272055Z 08006KT 4000 HZ FEW040 SCT100 31/19 Q0996 TEMPO 34015G35KT 2000 DRDU RMK QFE969 A29.43
OPLA,2022-05-27 21:25, OPLA 272125Z 32014KT 4000 HZ FEW040 SCT100 31/19 Q0997 TEMPO 34020G45KT 0800 DSTSRA FEW030CB RMK QFE969 A29.45
OPLA,2022-05-27 21:55, OPLA 272155Z 33018KT 4000 HZ SCT040 SCT100 31/18 Q0997 TEMPO 34020G45KT 0800 DSTSRA FEW030CB RMK QFE970 A29.47
OPLA,2022-05-27 22:25, OPLA 272225Z 36014KT 4000 HZ SCT040 SCT100 30/18 Q0996 TEMPO 34020G45KT 0800 DSTSRA FEW030CB RMK QFE969 A29.44
OPLA,2022-05-27 22:55, OPLA 272255Z 06010KT 4000 HZ FEW040 SCT100 30/18 Q0996 TEMPO 34015G35KT RMK QFE968 A29.42
OPLA,2022-05-27 23:55, OPLA 272355Z 14006KT 4000 HZ FEW040 SCT100 30/18 Q0995 TEMPO 34015G35KT RMK QFE968 A29.41

Table 11 Detailed METAR for AIIAP, Lahore

2.4.2. These are the surface observations at OPLA at the time. They indicate fairly dry air at the surface, in good agreement with the sounding above. They also show northwest winds peaking at 18 kt, outflow from the thunderstorm, passing through at around the incident time.

2.4.3. An analysis of the weather phenomenon for AIIAP, Lahore is as follows : -

METAR – OPLA (Allama Iqbal Airport Lahore, Pakistan)		
Parameter	**METAR Report 1 (212500 UTC)**	**METAR Report 2 (215500 UTC)**
Report Time	272125Z	272155Z
Wind	32014KT	33018KT
Visibility	4000m	4000m
Weather	HZ (Haze)	HZ (Haze)
Clouds	FEW040(few clouds at 4,000 ft), SCT100 (scattered clouds at 10,000 ft)	SCT040(scattered clouds at 4,000 ft) SCT100 (scattered clouds at 10,000 ft)
Temperature	31°C	31°C
Dew Point	19°C	18°C
Pressure	Q0997	Q0997
Temporary WX	34020G45KT, 0800 DSTSRA, FEW030CB	34020G45KT, 0800 DSTSRA, FEW030CB
Remarks	QFE969, A29.45	QFE970, A29.47

Table 12 METAR at AIIAP, Lahore

2.4.4. The METAR data for Lahore indicates the presence of Thunderstorm Rain conditions accompanied by strong winds.

2.4.5. **Terminal Aerodrome Forecast**. Report for OPLA: -

2.4.5.1. TAF OPLA 271545Z 2718/2824 12005KT 4000 HZ FEW100 TX41/2810Z TN28/2800Z TEMPO 2800/2803 09003KT 2500 FU FM 28,0500 09010KT 5000 HZ NSCTEMPO 2812/2816 05015G35KT 2000 DRDU FM 28,1600 13005KT 4000 HZ NSC=

TAF – OPLA (Allama Iqbal Airport Lahore, Pakistan)	
Issue Time	271545Z
Forecast Validity	From 2718Z to 2824Z
Initial Wind	120 °at 5 kt
Initial Visibility	4,000 m (Haze)
Initial Cloud Cover	Few clouds at 10,000 ft
Maximum Temperature	41°C (expected around 2810Z)
Minimum Temperature	28°C (expected around 2800Z)
TEMPO Changes	Between 2800Z and 2803Z
TEMPO Wind	090° at 3 kt
TEMPO Visibility	2500 meters (Smoke/Fog)
FM 280500	Changes from 28 May at 0500Z
FM 280500 Wind	090° at 10 kt
FM 280500 Visibility	5,000 m (Haze)
NSC	No Significant Clouds
TEMPO 2812-2816	Between 2812Z and 2816Z

Table 13 TAF Report at AIIAP, Lahore

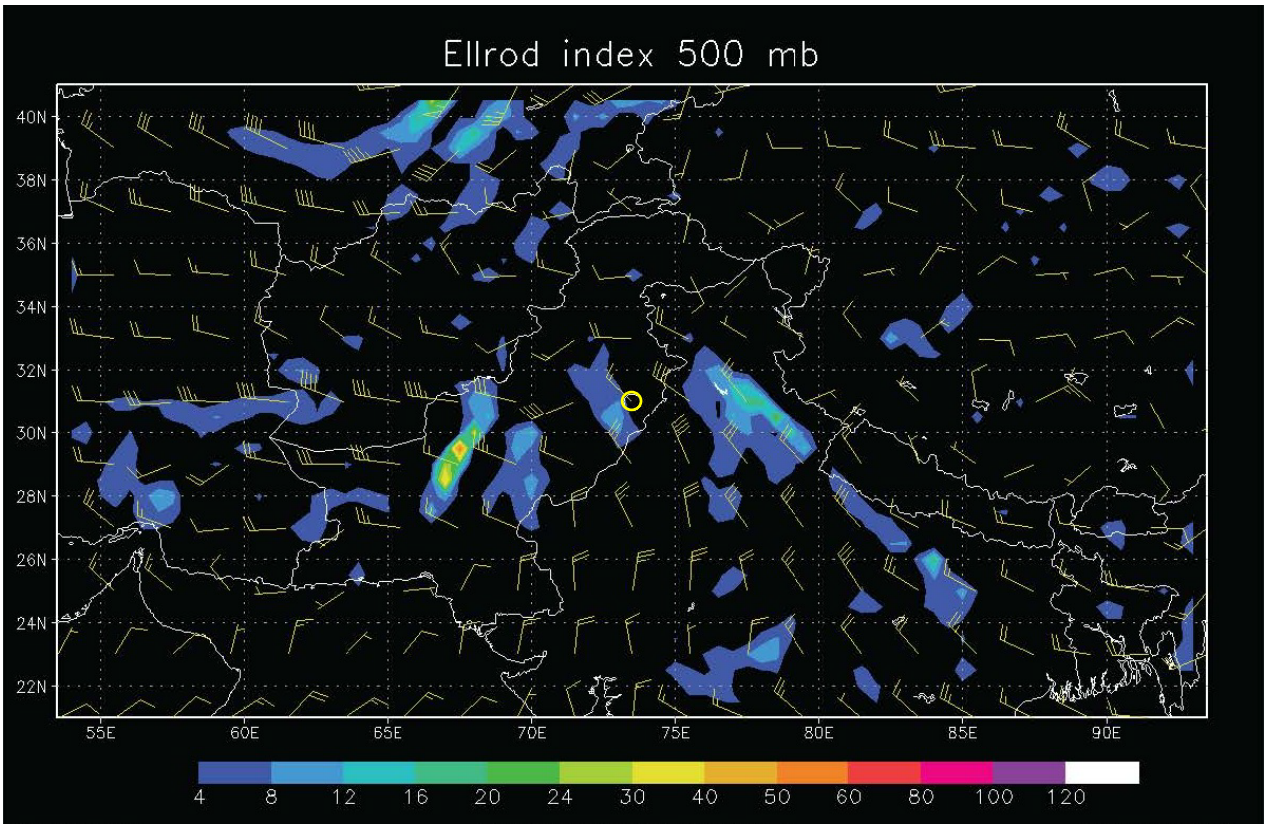
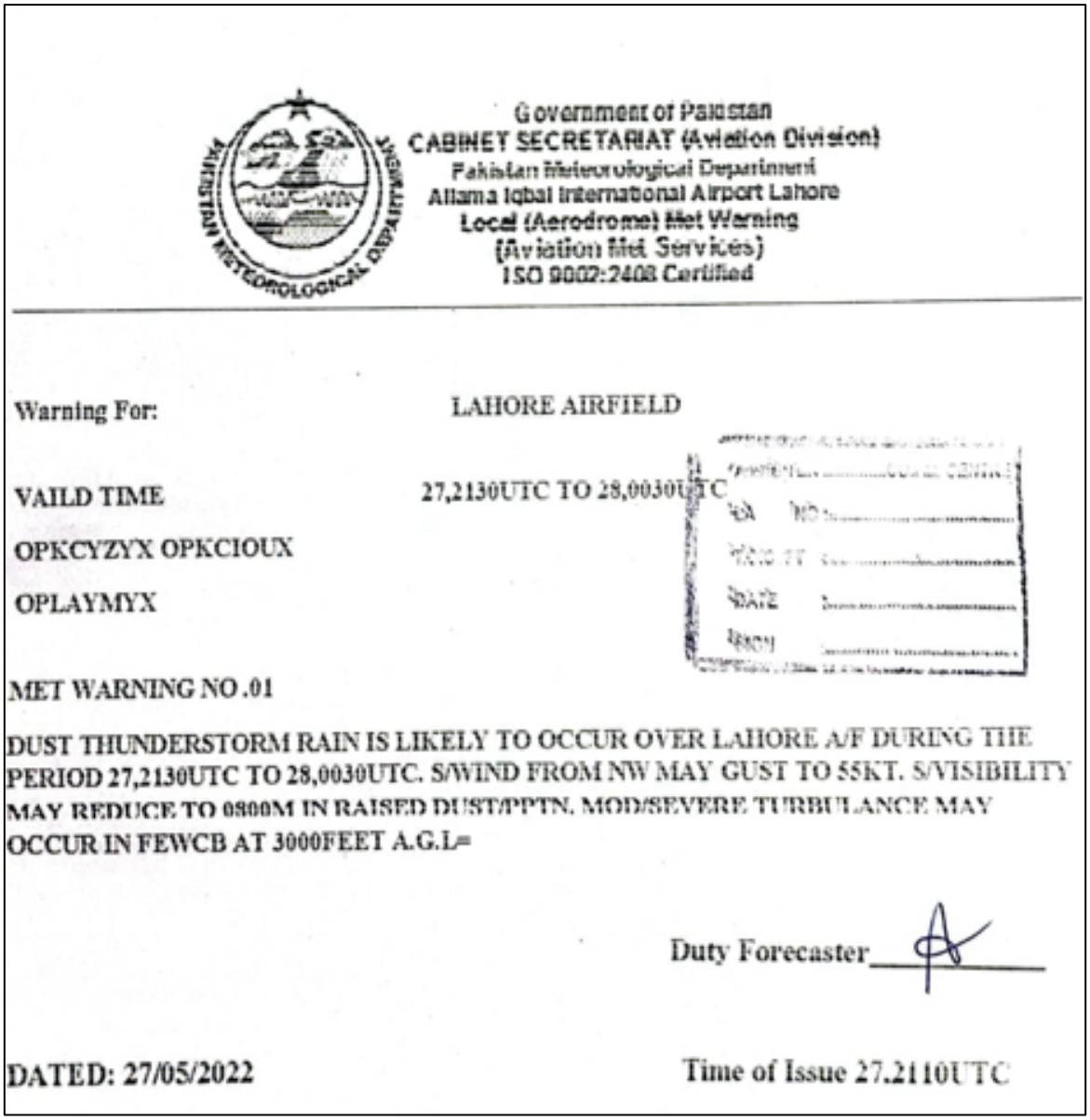


Figure 7 Atmospheric Physics

2.4.6. This is a short-range computer model forecast that depicts wind direction at speed at their incident time and altitude (the yellow wind barbs). Plotted in coloured blobs is a technique used to diagnose large scale turbulence. Large scale turbulence potential was not high, but this model cannot resolve thunderstorm-scale turbulence. Incident position is marked at the centre of the map with a small yellow circle. (Note: they were downwind of the thunderstorm cell.)

2.4.7. **Sig MET (Significant Meteorological Information) Warnings.** The weather warning for DUST TSRA with strong wind gusts up to 55 kt was issued at Lahore Airport which was valid for 27 May, 2130 h UTC to 28 May 0030 h UTC.



Government of Pakistan
CABINET SECRETARIAT (Aviation Division)
Pakistan Meteorological Department
Allama Iqbal International Airport Lahore
Local (Aerodrome) Met Warning
(Aviation Met Services)
ISO 9002:2408 Certified

Warning For: LAHORE AIRFIELD

VAILD TIME 27,2130UTC TO 28,0030UTC

OPKCYZYX OPKCIOUX

OPLAYMYX

MET WARNING NO .01

DUST THUNDERSTORM RAIN IS LIKELY TO OCCUR OVER LAHORE A/F DURING THE PERIOD 27,2130UTC TO 28,0030UTC. S/WIND FROM NW MAY GUST TO 55KT. S/VISIBILITY MAY REDUCE TO 0800M IN RAISED DUST/PPTN. MOD/SEVERE TURBULANCE MAY OCCUR IN FEWCB AT 3000FEET A.G.L=

Duty Forecaster

DATED: 27/05/2022

Time of Issue 27.2110UTC

2.4.8. **Satellite Imagery.** The satellite image captured prior to, during and after the event is as follows: -

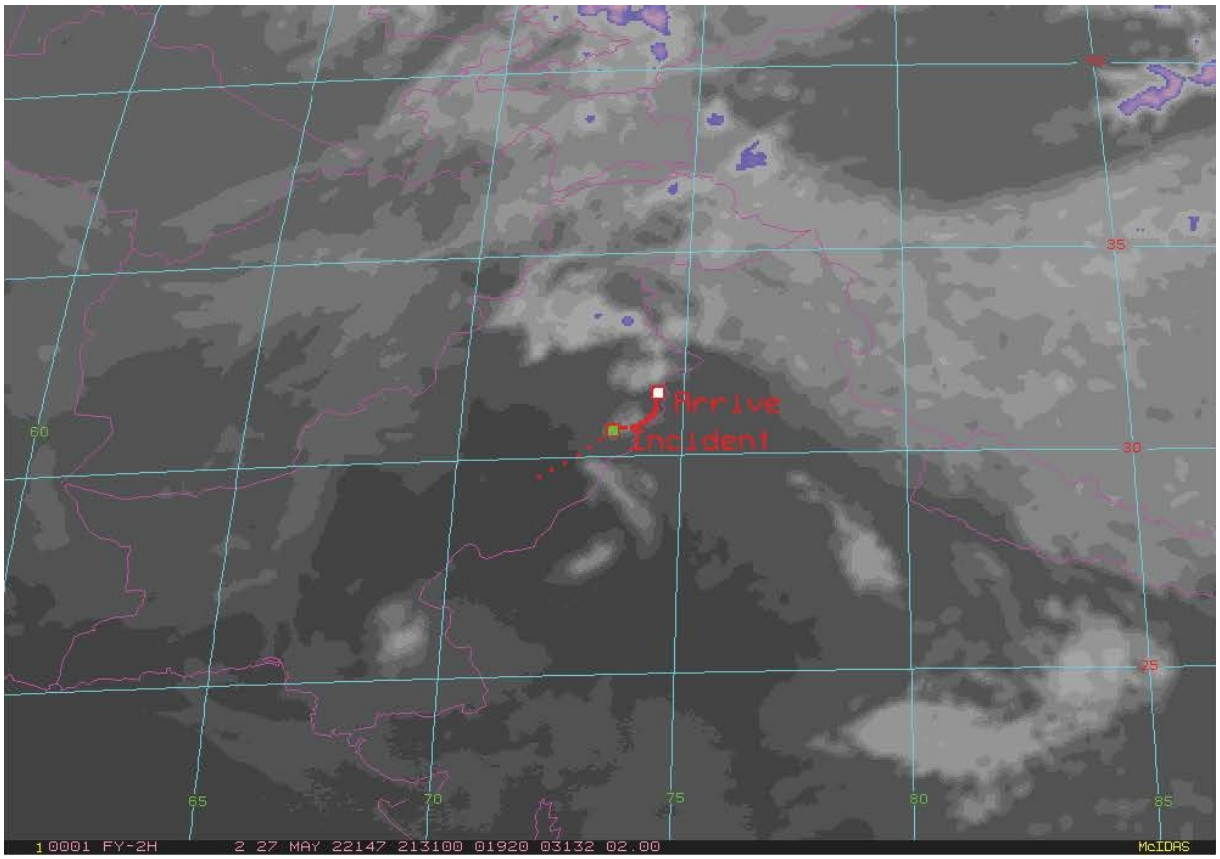


Figure 8 Satellite Image of Incident

2.4.9. This image was taken by a satellite at 2130Z. The red dots (or line where the dots are close together) are the track (from www.flightradar24.com). Coincidently position data become significantly more frequent at the location of the incident. Bright white colours are associated with cold high cloud tops and stronger cells (gone by the incident time but present just before, see attached loop). At the incident time, a thunderstorm located ~50 NM north of the incident position had just dissipated or was in the final stages of dissipating. An attached loop of a few hours shows the dissipating trend. The aircraft flew through the outflow of this storm, with an outflow boundary probably marked by the small band of clouds at the incident position. These smaller clouds are usually benign.

2.4.10. **Thunderstorm Dissipation.** Severe turbulence caused by thunderstorms is a well-recognized meteorological hazard in aviation. Thunderstorms are known for producing severe turbulence, both within the storm itself as well as in the surrounding areas. The severity of turbulence near a thunderstorm depends on several factors, including the storm's size, intensity, and the presence of certain meteorological conditions.

2.4.11. As far as the occurrence is concerned, significant weather with thunderstorms was mostly present in the North of Lahore City. However, this storm was in the dissipation stage, with an extension of the weather system towards the South of Allama Iqbal International Airport, Lahore. As the incident happened in the Approach of Lahore Airport, the turbulence in all probability was due to the impact of the dissipating thunderstorm in the said area. During the dissipation phase, thunderstorms can cause turbulence in areas away from the immediate surrounding of the active cell. However, this was an exceptional case whereby the effects of the turbulence with its severity were experienced at a distance of 35-

40 NM from the active cell. The presence of a stable atmospheric layer on top served to amplify the effects of this dissipation. Since the stability of the atmospheric layer prevented the vertical dissipation of the storm cell, the effects were propagated horizontally through the atmosphere reaching as far as 40 NM. The occurrence is thus an exceptional phenomenon which could neither be foreseen nor could be avoided thereby resulting in injuries to Cabin Crew and passengers.

SECTION 3 - CONCLUSIONS

3.1. **Findings**

3.1.1. ETD-72K was a scheduled passenger flight from Abu Dhabi UAE to AIIAP, Lahore Pakistan.

3.1.2. Ground operations were normal and the flight remained uneventful till TOD.

3.1.3. Approach brief was conducted by the Flight Crew prior to TOD point.

3.1.4. ETD-72K established radio contact with ACC East at 212700 and was No. 1 aircraft for landing.

3.1.5. The weather was updated 90 minutes prior to landing which showed a CB cloud 30-40 NM north of the airport. Moreover, ATIS also gave the information of weather warning for Dust Thunderstorm Rain with visibility 800 m and wind 20 kt gusting up to 45 kt. However, the weather information was not passed to the Flight Crew by ATC.

3.1.6. During descent for AIIAP, the aircraft weather radar showed an active weather cell 80 NM ahead, which was also visible to the Flight Crew due lightning.

3.1.7. The Flight Crew decided to deviate 20 NM to the east to avoid the active weather.

3.1.8. After approval from ACC, the aircraft turned onto HDG 060º, approximately 40 NM from the weather cell while crossing FL 200 at a speed of 290 kt.

3.1.9. As soon as the aircraft turned onto HDG 060º, it entered clouds and immediately encountered an updraft for 6 – 7 seconds followed by severe turbulence for the duration of 3 – 4 minutes.

3.1.10. Due to the sudden updraft encountered, the aircraft was subjected to +ve 1.8 and -ve 0.75 Gs.

3.1.11. As the turbulence hit the aircraft, a sharp left control input was commanded by the Flight Crew which resulted in AP disconnection due to override force.

3.1.12. The aircraft continued under manual control for another 30 s without any exceedances being recorded after which AP was reengaged.

3.1.13. The Flight Crew requested further easterly HDG for weather avoidance which was initially denied but subsequently permitted.

3.1.14. At this time, seatbelt signs had been turned on while passing FL260 approximately four (04) min prior to the turbulent event. However, the Cabin Crew were attending their tasks in the aircraft.

3.1.15. The Captain inquired from the Cabin Crew regarding any injuries and was informed that 02 Cabin Crew and some passengers had sustained injuries. As the aircraft changed over to Approach Control for final approach, the Flight Crew informed about one injured Cabin Crew member.

3.1.16. After the aircraft was parked, it was learnt that three (03) passengers and eight (08) Cabin Crew had sustained injuries.

3.1.17. Only one ambulance was available to transport 11 injured personnel to hospital. Despite repeated requests, the second ambulance could not be made available.

3.1.18. Due to the nature of the injuries, one Cabin Crew was admitted in hospital while the rest were cleared by hospital after requisite First Aid.

3.1.19. Analysis of the weather revealed that the active weather cell present north of AIIAP, Lahore was in the dissipating stage.

3.1.20. Due to the presence of stable atmospheric layer on top, the effects of dissipating weather propagated at farther than normal ranges.

3.1.21. As it was not visible of weather radar, the turbulent effects of dissipating thunderstorm could not be avoided.

3.2. Causes / Contributing Factors

3.2.1. **Cause:** In flight Turbulence Encounter (TURB) as a result of dissipating thunderstorm.

3.2.2. **Contributing factors.** Presence of stable atmospheric layer above leading to propagation of dissipation effects at farther than normal distance.

Note: Aviation Occurrence Category (ADREP Taxonomy)

"Turbulence encounter (TURB)": *In-flight turbulence encounter*

- *Includes encounters with turbulence in clear air, mountain wave, mechanical, and/or cloud-associated turbulence.*
- *Wake vortex encounters are also included here.*
- *Flights into wind shear or thunderstorm-related turbulence are coded as Wind Shear or Thunderstorm (WSTRW).*
- *Includes turbulence encountered by aircraft when operating around or at buildings, structures, and objects.*

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SECTION 4 – SAFETY RECOMMENDATIONS

4.1. Safety Recommendations

4.1.1. Etihad Airways

4.1.1.1. Cabin services may be terminated close to vicinity of active weather to avoid injuries to personnels.

4.1.1.2. During active weather, the Flight Crew may regularly consult ATIS to get weather update or may request ATCOs to update on latest weather.

4.1.2. PAA

4.1.2.1. PAA may ensure sufficient number of ambulances and drivers available at all airports to cater for transportation of multiple patients during medical emergencies.

4.1.2.2. During active weather, any changes in weather passed by MET may be communicated to Flight Crew by ATCOs.