

Aviation Safety and Aircraft Accident and Incident Investigation Symposium

Abu Dhabi, United Arab Emirates,

19 to 21 November 2024

“Presented by Ethiopian Aircraft Accident & Incident Investigation Bureau”

Discussion on Completed Accident & Incident Investigation and Lessons Learned

Conti..

Objectives of the Presentation

- Share Experiences with States
- Maintain the confidence of the aviation industry and the public that accidents and incidents are thoroughly investigated;

Conti...

B737-8MAX Accident summary

- The presentation focuses on **ET302, B737-8MAX** which encountered fatal accident after takeoff from Bole International airport bound to Nairobi –Kenya;
- On 10th March 2019 at around 05:44 UTC, B737-8MAX, flight ET302 disappeared from radio and radar contact;

Conti....

- The FDRE Ministry of Transport & Logistics and EAIB were informed the lose of flight ET 302
- The Ethiopian Authorities launched a technical investigation group that was formed by a ministerial decree issued by the Minister.

Conti....

- Aboard there had been **157 passengers**
(**8 crew and 149 passengers**);
- Nearly after **19** hrs. of the accident, **Notification** was
dispatched to the State's Organizations as per **Annex-13**

Conti...

The investigation, group was initially established from different specialties:

- Operations group
- Maintenance & Airworthiness group
- Power plant group
- DFDR and CVR group
- ATS & Metrology Services group
- Autopsy Examination

There were a minimum of 3-4 people in each group. Later on the group merged into operations, systems and DFDR- CVR groups

Conti...

As per Annex 13 provisions, the investigation group organized to assist the EAIB:

- **ECAA and EAG**- Technical Advisors;
- **NTSB** - Accredited Representative State of Design & Manufacturer;
- **BEA** - Accredited representative, State which provided facilities & experts for the read out of DFDR & CVR;
- **EASA**-Advisor for **EAG** group during preliminary report only

Conti...

The investigation executed in accordance with legal documents:

- ICAO Annex 13
- EAIB's approved Proclamation 957/2016,
- EAIB Rules and Standards,
- Policy and Procedures Manual

Conti....

Synopsis

- Aircraft – **B737-8MAX**, registered ET-AVJ
- Date and time - 10 March 2019 at 05: 38 UTC
- Operator- **Ethiopian Airlines Group**
- Place of **Accident - 28 NM South East of Addis Ababa Bole International Airport**
- Type of flight - Scheduled passengers **flight ET 302**

Conti...

- Addis Ababa (Ethiopia) – Jomo Kenyatta (Kenya) Int. Airport;
- Persons on board - **Captain; First - Officer; 5 Cabin Crew; one In Flight Security Officer (IFSO); 149 passengers from different countries.**

Conti...

Accident Site



03/10/2019

Conti...

On March 20, 2019; the wreckages were collected from the sight by Ethiopia employees & transported to Addis Ababa EAIB store.



Conti...

- **DFDR and CVR Recovery**

On 11 March 2019, the DFDR and CVR were recovered from the accident site by the EAIB

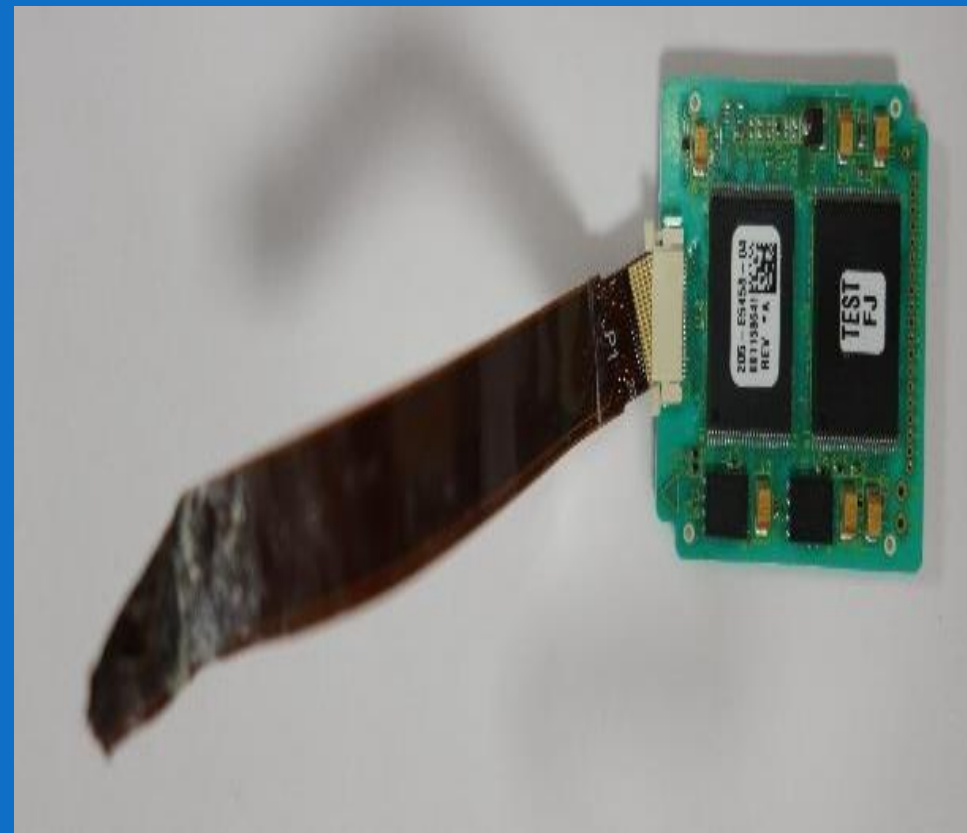


Conti...

- As per the Ethiopian Government decision and agreement between the **FDRE MOTL** and the **French Bureau** d'Enquêtes et d' Analyses pour la sécurité de l'aviation civile (BEA), the **DFDR** and **CVR** were transported to French BEA read at the BEA facilities.
- By the request of Ethiopia and as per **Annex 13 Article 5.23**, BEA has appointed an accredited representative and assisted EAIB for the analysis of DFDR data.

Conti...

- The FDR downloaded & analyzed by **BEA & EAIB team**
- The CVR data downloaded and **transcribed by EAIB**



Conti...

As per **Annex-13 and the EAIB Rules and Standards**; the investigation group assessed all documents & data, the relevant records of

- AFM, AMM, AML, FCOM,
- DFDR, CVR,
- ATS communication,
- test and researches,
- Boeing documents,
- crew training and proficiency and other pertinent information collected and analysis done accordingly.

Conti...

Four Major examination were carried out:-

- 1. Column force & manual trim force evaluation using B737-8-MAX CAE-Training Simulator at Ethiopian Airlines;**
- 2. Flight deck environment & column force evaluation using the Boeing Engineering simulator (ECAB) in Seattle;**
- 3. Manual Trim evaluation using Flight Controls Test Rig (FCTR) in Seattle;**
- 4. Collin's presentations.**

Conti...

Chronological history of flight was reproduced from verified data retrieved from the Aircraft DFDR, CVR, Air Traffic Control (ATC) radar recordings and transcripts.

- **Phase 1:** From takeoff to Autopilot engagement
- **Phase 2:** Under Autopilot engagement
- **Phase 3:** From A/P disconnect to stabilizer trim cutout

Conti...

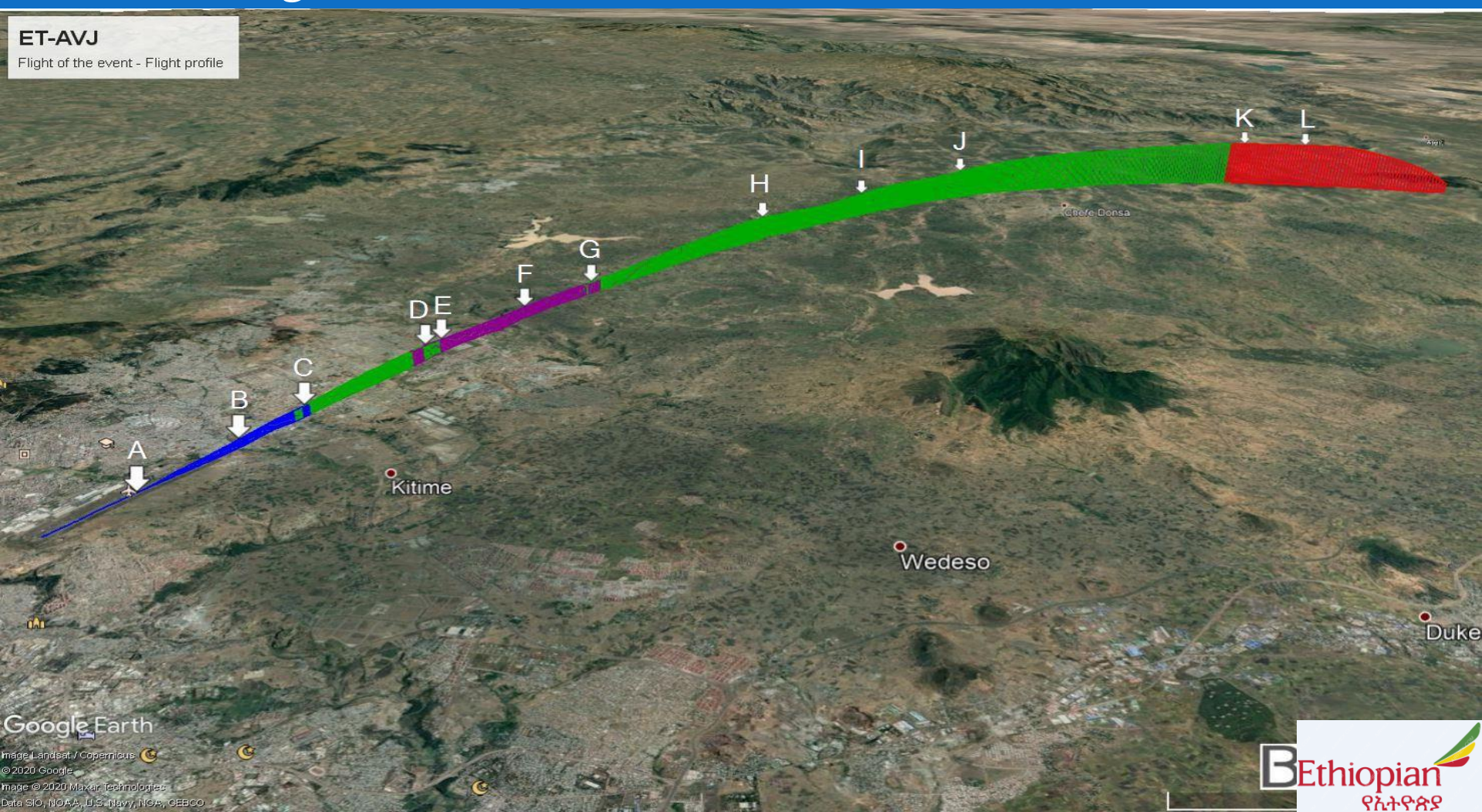
- **Phase 4:** flight while the stab trim cutout switches were in the cutout position
- **Phase 5:** Stab trim cut out switches back in normal position until the end of the flight

Conti...

History of Flight

Phases of Flight

ET-AVJ
 Flight of the event - Flight profile



Google Earth

Image Landsat / Copernicus
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 Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Conti...

- The takeoff roll and lift-off was normal, including normal values of left and right angle-of-attack (AOA);
- Shortly after liftoff, the left Angle of Attack sensor recorded value became erroneous and the left stick shaker activated;
- The left and right recorded AOA values began deviating, the left AOA value reached 74.5° in $\frac{3}{4}$ seconds while the right AOA reached a maximum value of 15.3° ,

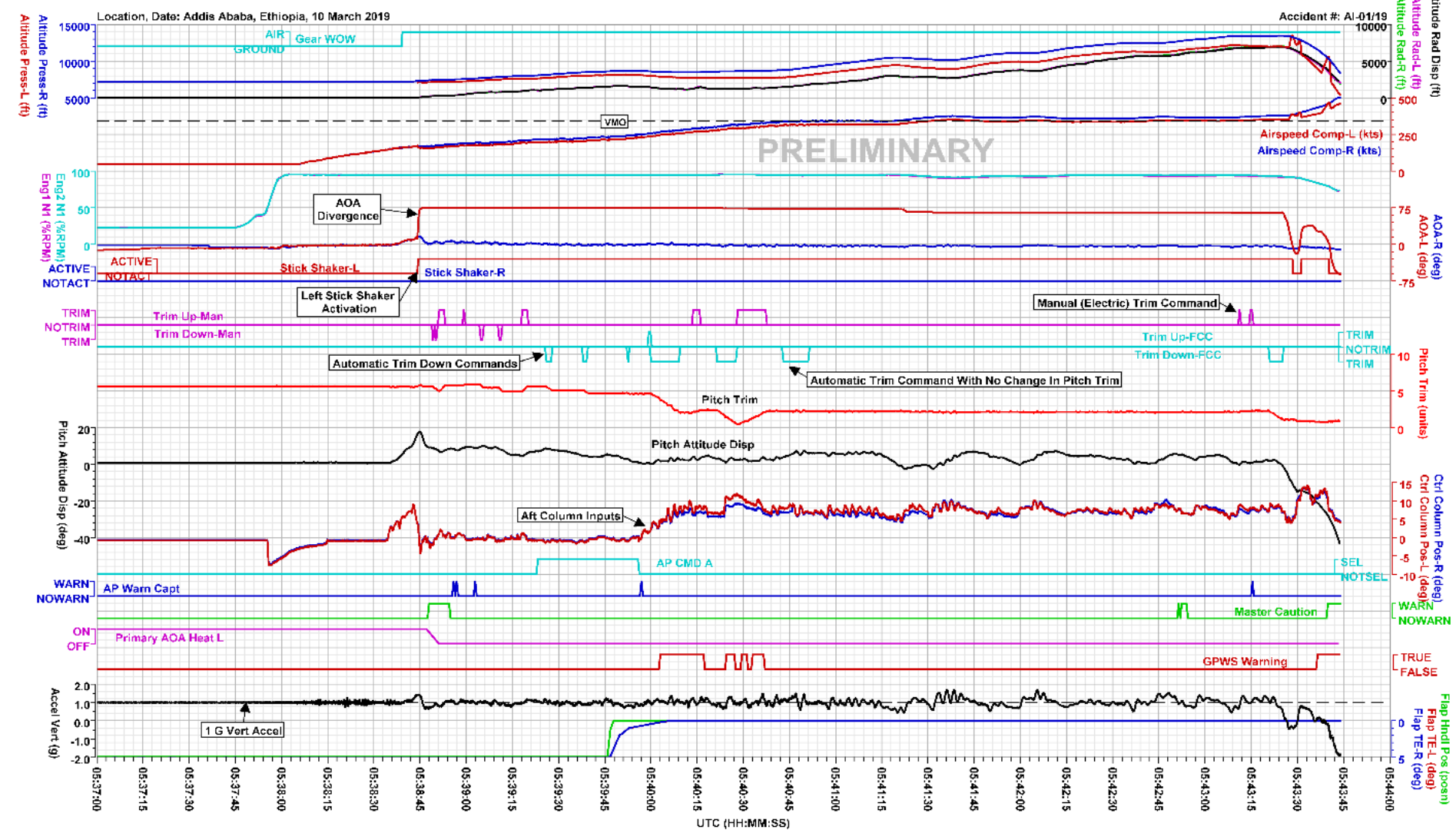
Conti...

- Cockpit noise environment was unsettling and further impacted the flight crew's concentration;
- MCAS denied trim authority and made it difficult to control the airplane from excessive nose dive and crashing
- According to the analysis MCAS triggered nose down four times and impacted to the ground six minutes after liftoff;

Conti...

ET -AVJ 737-8MAX General View of FDR Data Analysis

ET302 Preliminary FDR Data



Conti....

- Maintenance actions of relevance started occurring in **December 2018** when the airplane was one month old and included several pilot write ups involving temporary fluctuations of vertical speed and altitude.
- There had been reports of **airplane roll during autopilot operation.**
- The airplane was only **four months old** at the time of its accident.

Conti...

Some of the findings considered in this presentation:

- Prior to the Lion Air accident, the manufacturer obscured any information related to MCAS on B737-8 (MAX);
- Failure by the manufacturer to design simulator training for pilots on new critical MCAS systems;
- Production problems & intermittent electrical/ electronic system failure involving the airplane's Electrical Wiring Interconnection System (EWIS) and the AOA Sensor part;

Conti...

Contributing Factors

- MCAS design which was relied on a single AOA sensor;
- Intense Stick shaker a sudden increase in the crew's stress and workload which impacted the crew performance;
- Multiple alerts, stick shaker, repetitive MCAS activations impact ;

Safety Recommendations:

Challenges during ET 302, B737-8MAX Accident Investigation:

- Shortage of well qualified investigators in different qualifications;
- Low experiences with major Accident Investigations;
- **DFDR** reading facility and capability to analyze down loaded data;
- Organization's **Conflict of Interest**;
- Interference from involved parties. (**Police force, rural community, internal & external media etc...**)

Conti...

- unnecessary shifting of **relevant wreckages from its position**
- Local police commitment
- Transparency
- Obtaining factual and comprehensive **eyewitness** statements;
- **Financial** challenge, etc...

“We Strive for Safety”

Thank You