



AIR, MARITIME AND RAILWAY ACCIDENT
INVESTIGATION NATIONAL BOARD
9, Dyakon Ignatiy Street, 1000 Sofia, Bulgaria

Safety Investigation Report

Ref.:
AAIU-2018-14

Issue date:
December 28, 2022

Status:
FINAL



**ACCIDENT, OCCURRED ON AUGUST 31, 2018,
INVOLVING CESSNA 680 AIRCRAFT, REGISTRATION
MARKS TC-OYD, OPERATED BY „BOYDAK AIR“.**

Purpose of Report and Responsibility Level

Under Annex 13 of the Chicago Civil Aviation Convention of 07.12.1944, Regulation 996/20.10.2010 of the European Parliament and the Council on the investigation and prevention of accidents and events in Civil Aviation and Ordinance No. 13/27.01.1999 of MT (last amendment and addition - 22.01.2016), the investigation of an aviation event aims at identifying the reasons that led to the event to eliminate and exclude these in future **without identifying someone's guilt or liability**.

CONTENTS

List of abbreviations	4
1. Introduction	5
2.1. Flight History	5
2.1.1. Flight number and type, the last point of departure and time, and planned destination point	5
2.1.2. Flight preparation and description of the flight	6
2.1.3. Location of aviation occurrence	8
2.2. Injuries to persons	8
2.3. Damage to aircraft	9
2.4. Other damages	15
2.5. Personnel information:	16
2.5.1. Pilot in command	16
2.5.2. Co-pilot	16
2.6. Aircraft Information	16
2.6.1. Airworthiness Information	16
2.6.2. Aircraft characteristics	17
2.6.3. Information on the used fuel	18
2.7. Meteorological information	18
2.8. Navigation systems	18
2.9. Communication systems	18
2.10. Aerodrome information	19
2.11. Flight recorders	19
2.11.1. FDR (Flight Data Recorder)	19
2.11.2. CVR (Cockpit Voice Recorder)	19
2.12. Information about the impact and the debris	20
2.13. Medical and pathological information	21
2.14. Fire	21
2.15. Factors for Survival	21
2.16. Tests and research	21
2.17. Flight Crew Operating Manual	22
2.17.1. Abnormal and Emergency Procedures – Nosewheel Steering Malfunction	22
2.17.2. Pilot's AP/TRIM/NWS DISC Switch – Operation	22
2.17.3. “Memory items”	22
2.18. Additional Information	22
3. Analysis	23
4. Conclusion	26
4.1. Findings	26
4.2. Causes	27
5. Safety Recommendations	27

ANNEX 1

List of abbreviations

A/C	- Aircraft;
A/THR	- Auto thrust;
AAIU	- Aviation accident investigation unit;
AGL	- Above ground level;
ALT	- Altitude;
AMRAIU	- Aircraft, Maritime and Railway Accident Investigation Unit;
AO	- Airline operator;
AP	- Autopilot;
ARP	- Aerodrome reference point;
ATCO	- Air Traffic Controller
ATIS	- Automatic terminal information service;
ATPL	- Airline transport pilot license;
ATS	- Air Traffic Services;
BULATSA	- Bulgarian Air Traffic Services Authority;
CAA	- Civil Aviation Act;
CAMO	- Continuing airworthiness maintenance organization;
CNP	- Control navigation point;
CR	- Capital Repairs (overhaul);
CVR	- Cockpit Voice Recorder;
DG CAA	- Directorate General Civil Aviation Administration;
EASA	- European Aviation Safety Agency;
FDR	- Flight Data Recorder;
FH	- Flight hour;
FL	- Flight level;
FM	- Flight Manual;
FO	- First officer;
ft	- Foot;
GW	- Gross Weight;
ICAO	- International Civil Aviation Organization;
IFR	- Instrument Flight Rules;
kt	- Knots;
Lbs	- Pound (0,4535923 kg);
MAG	- Magnetic heading;
MEP	- Multi Engines Power;
MO	- Maintenance organization;
MP	- Maintenance Programme;
MSN	- Manufacturer Serial Number;
MTITC	- Ministry of transport, information technology and communications;
MTOW	- Maximum Take-Off Weight;
NM	- Nautical Mile;
p.	- page;
PIC	- Pilot in Command;
RWY	- Take-off/Landing runway;
SOP	- Standard operating procedures;
TLB	- Technical log book;
UTC	- Universal Coordinated Time;
V/S	- Vertical speed.

1. Introduction

Date and time of the aviation event: 31.08.2018, 10:34 h UTC.

All times in the Report are given in UTC.

Notified: Aircraft, Maritime and Railway Accident Investigation Unit Directorate (AMRAUD) and Directorate General "Civil Aviation Administration" (DG CAA) of the Republic of Bulgaria, the European Commission, the European Aviation Safety Agency (EASA), The International Civil Aviation Organization (ICAO), the National Transportation Safety Board (NTSB) of the USA and Maritime Affairs and Communications Accident Investigation Board of Republic Turkey.

On the grounds of the provisions of Article 9, para.1 of Ordinance No. 13, dated 27.01.1999, on Investigation of Aviation Accidents; the occurrence was classified as an accident by the Aircraft Accident Investigation Unit at the Aircraft, Maritime and Railway Accident Investigation Unit Directorate (AMRAIU) at the Ministry of Transport, Information Technology and Communications. The materials on the aviation occurrence have been filed in case No. 14/31.08.2018 in AAIU archives. In accordance with the provisions of Article 5, para.1 of Regulation (EU) No. 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, Article 142. Para. 2 of the Civil Aviation Act of the Republic of Bulgaria, dated 01.12.1972, and Article 10, para. 1 of Ordinance No. 13 of the Ministry of Transport, dated 27.01.1999, on the Investigation of Aviation Occurrences, by Order No. RD-08-383, dated 07.09.2018 of the Minister of Transport, Information Technology and Communications, a Commission is appointed for investigation of the accident.

Summary:

On 31 August 2018, while performing flight from Baku (Azerbaijan) without PAX on board, a Cessna 680 with registration TC-OYD of BOYDAK HAVACILIK A.S operator, was executing a RNAV approach to runway 04 of Burgas airport (Bulgaria). At approx. 10:34 UTC during the rollout a few seconds after the touchdown, the aircraft veered to the right from the centerline, left the runway nearby the C taxiway, hit a concrete block with aeronautical equipment and stopped on the ground between the apron and the runway.

The flight crewmembers were not injured, but the aircraft received damages on the left nose part of the fuselage and the left brace strut of the nose gear was broken.

Because of the investigation, the Commission considers that the accident is due to the following reason:

Probable technical failure of the nose wheel steering of the aircraft after touchdown and the following errors made by the flight crew during the roll phase after landing at Burgas airport:

- Not deploying spoilers to maximum position;
- Delayed in engaging reverse thrust of both engines;
- Ineffective differential braking;
- Failure to perform the emergency procedure prescribed in the FCOM in the case of malfunction of the nose wheel steering system.

2. Factual information

All the facts of the flight history, its preparation and realization, as well as the realization of the aviation event, the Commission received from the flight crewmembers, the crew records, witness explanations and the BULATSA data at Burgas Airport.

2.1. Flight History

2.1.1. Flight number and type, the last point of departure and time, and planned destination point

Flight Number: TC-OYD.

Type of flight: Relocation.

Last point of departure: Baku Heydar Aliyev International Airport (UBBB), Azerbaijan.

Take-off time: 07:30 h.

Planned destination point: Burgas Airport (LBBG), Bulgaria.

2.1.2. Flight preparation and description of the flight

The description of the preparation and realization of flight is done on the grounds of the records of radio communication, conversation and voice in the cockpit (CVR), data from FDR, the radar picture, the explanations of the crew and the studied company documents, related to the flight realization. Before the flight all crew briefings, equipment and documents checks and pre-flight inspection were performed

On August 31, 2018, the CESSNA 680, aircraft with registration marks TC-OYD was performing a relocation flight on the route Baku (UBBB) Azerbaijan - Burgas (LBBG) Bulgaria.

At 07:18:10 the flight crew started, engine 2 and at 07:20:25 engine 1. Anomalies of engine parameters not observed.

At 07:22:10, the aircraft started taxiing and at 07:23:16, the flight crew set to 7° the flaps.

The taxiing is performed at an initial speed of 10 Kt, then at an average speed of 20 kt. No detected anomalies in the engines parameters during the taxiing. The average fuel flow is accordingly Eng #1 FF – 230 lbs/h; Eng #2 FF – 285 lbs/h.

At 07:30:02, the aircraft TC-OYD take-off from Baku (UBBB) from RWY 17 with flaps set at 7° and fuel quantity - Fuel Qty 10723 Lbs. The wind speed at this moment is 2.4 kt/70°. All gears are retracted at altitude - Radio Alt = 202 ft. Flaps are set to 0° at altitude Radio Alt = 1382 ft the position. Autopilot is engaged at height Press Alt 12112 ft. There are no anomalies in engine parameters during departure and initial climb. The flight to Burgas (LBBG) is performed normally, without deviations, in transition levels FL 400 and FL 430.

At 09:57:24, the aircraft started approach with calibrated speed - Calibrated Airspeed 206 kt and average vertical speed 1000ft/min. Twice, at 10:08:53h and at 10:18:13h for about 10 seconds, the vertical speed reaches 6000ft/min.

At 10:29:01 on barometric altitude - Press_Alt = 3500 ft and speed – Calibrated-Aispd = 198 kt the flight crew set to 7° the flaps

At 10:29:30, the flight crew of TCOYD established contact with Burgas Tower and ATCO issued a clearance for landing.

The flight crew: „Tower, Good Morning komshu, TCOYD with you RNAV approach RWY 04, RWY in sight, 4nm final.”

ATCO Tower: „Good Day TCOYD, Burgas Tower RWY 04 Cleared to Land. Wind 120° 12kts”
EBC: Wind copied, Cleared to Land RWY04, thank you!”

At 10:30:57 on radio altitude - Radio Alt = 1900 ft and speed – Calibrated-Aispd = 158 kt the flight crew set the flaps on 15°.

At 10:31:50 on radio altitude - Radio Alt = 1244 ft and speed - Calibrated_Aispd = 151 kt the flight crew set the flaps on 35°.

At 10:31:22, the flight crew disengaged the autopilot.

At 10:31:37 at a height of Radio Alt 1596 ft and speed Calibrated-Aispd = 153 kt the flight crew extended the landing gears. The aircraft is in full landing configuration and prepared for landing.

At 10:33:09 the aircraft reached a decision height of 428 ft set by Pilot in Comand and First officer.

10:33:48 the touch down point is detected at radio altitude, vertical acceleration and change of the sign of the vertical speed.

The aircraft landed at 10:33:50 at RWY 04 with CAS = 100 kt and vertical acceleration $V_{acc} = 1.31g$. Wind speed at this time is 8.8 kt / 124°.

Engines parameters during touchdown are:

	Engine 1	Engine 2
N1	30,3 %	30,3 %
N2	69 %	68,6 %

Rud Force Pilot L Outbd 37.62 Lb, Rudder Ctrl -3.1 Deg, Rud Surf Posn #1-8 Deg -2.74
Roll Att #1 Deg -3.2

During braking, air brakes reverse on both engines and brake on landing gear are used as follows:

At 10:33:53 the spoiler control lever (Speed Brake) is deflected. Registered the spoiler lever position (Spdbrk Lever # 1 / # 2) are respectively: 1.3; 2; 1.4; 1.4 %. The recorded values do not correspond to the expected maximum deviations of the lever - 57°.

At 10:33:54 Roll Att #1 Deg -3.49, Rud Surf Posn #1-8, Deg -4.1, GND Speed Knots 95

At 10:33:56 is registered Rudder control command at -8.1 degrees from Pilot L and Rudder deflection of -8.9 degrees. Rudder Command comes from Pilot Side (Captain)

Rudder Ctrl -8.1 deg, Rud Surf Posn -8.9 deg, Roll Att #1 Deg -3.6, GND Speed Knots 93.7

Rud Force Pilot L-Outbd 51.35 Lb, Rud Force Coptl L-Outbd 20.9 Lb, Lat Acc: 0.17 g

At 10:33:57 is registered simultaneous Simultaneous operation of left and right brakes on the Captain's side. Higher pressure on the left brakes.

Brake Ped Pilot Left #1, #2 “Apply”, Brake Ped Pilot Right #1, #2 “Apply”, GND Spd 93 Kts.

At 10:34:01 is registered operation of the reverse thrust of Engine 1 and Engine 2(T/R Deploy) and activation of left and right brakes by Captain and First officer.

GND Speed Knots 76.5

During the reverse thrust, the engines parameters are as follow:

-	Engine 1	Engine 2
TLA	16,35°	11,61°
N1	28,3 %	24 %
N2	65,3 %	57,3 %

At 10:34:03 is registered Rudder control command at -4.6 degrees and rudder deflection of -5 degrees
Roll Att #1 Deg -3.7, Rud Force Pilot L-Outbd 29.45 Lb, Rud Force Coptl L-Outbd 19.78 Lb

At 10:34:04, the aircraft started turning right with an indicated airspeed 84 kt and a ground speed of 86.5 kt. Rud Surf Posn #1-8 Deg: -5, Roll Att #1 Deg: -3.69, GND Speed Knots: 69.5, Lat Acc: 0.34

At 10:34:05 The left brakes on side of the first officer was operated and then was operated left and right brakes on from the Captain and the First officer. Variable pressure of the four brakes. Rudder

control command at 0.39 degrees and rudder deflection at 2.39. Indicated air speed 65 kt. and a ground speed 65 kt.

At 10:34:07, on the ground speed 61,3 kts the aircraft left the RWY04 at a distance of 1480 m from its threshold.

At 10:34:10 Rudder control deflection at -3.6 degrees and rudder deflection on -3.2. Indicated air speed is 44 kt and the ground speed is 40 kt. The left and right brakes are triggered by Captain and First officer. Variable pressure of the four brakes.

10:34:11 Signal hydraulic “Low Pressure” for 2 seconds. Parameters A1580 __Hyd_Pres_Low_L, A1585 __Hyd_Pres_Low_R. Hydraulic Volume decrease from 290 cu/in to 230 cu/in. Parameter A1590 __Hyd_Volume_Cu_In.

At 10:34:13 Rudder control deflection at 5 degrees and rudder deflection on 7.7. Indicated air speed is 30 kt. and a ground speed is 27 kt. The left and right brakes start working by Captain and First Officer. Variable pressure of the four brakes.

10:34:14 Signal for Nose Landing Gear “Down & Locked” change the state to “Not Down & Locked”. Parameter A0825 __Land_Gear__Nose

At 10:34:17, turn off right-hand engine reverse at 5 kt ground speed. The brakes are triggered by PIC and FO. Variable pressure of the four brakes.

At 10:34:18, turn off left-hand engine reverse at 5 kt ground speed. The brakes are triggered by PIC and FO. Variable pressure of the four brakes.

At 10:34:20 the aircraft is completely stopped about 108 m south-east from RWY centre, at heading 32, at a distance of 1650 m from RWY04 threshold. When leaving the runway, the aircraft passes through a side lamp from the runway lighting and hit the power and communication box of the anemometer of an aeronautical equipment. The brakes are triggered by PIC and FO. Maximum brake pressure.

At 10 34 17, ATCO Tower asked the flight crew if it needed any assistance to which the flight crew replied in the affirmative.

ATCO Tower: *TCOYD do you need any assistance*”

Flight crew: *Yes Sir*

At 10:36:00, the flight crew left the aircraft alone without injury.

2.1.3. Location of aviation occurrence

Location: Burgas Airport (LBBG) Bulgaria;
 Date and time: 31 August 2018, 10:34:06 UTC;
 Lighting conditions: Daylight
 The control point is with coordinate's [N 42° 34' 11.244" E 27° 30' 59.258"](#).

2.2. Injuries to persons

<i>Injuries</i>	<i>Crew</i>	<i>Passengers</i>	<i>Total in the aircraft</i>	<i>Others</i>
<i>Fatal</i>	0	0	0	0
<i>Serious</i>	0	0	0	0
<i>Minor</i>	0	0	0	0
<i>None</i>	3	0	3	<i>Not applicable</i>
<i>Total</i>	3	0	3	0

The crew did not have any injuries.

2.3. Damage to aircraft

During the inspection of the aircraft at the site of its final stop, the following damage were found:



Fig. 1

- Cracks, large scratches in Radome.
- Dents in sheetmetal of Nose, Forward Fuselage and damaged antennas.



Fig. 2



Fig.3

- Dents in gear doors.



Fig. 4

- Damaged left bearing beam of nose landing gear.



Fig. 5

- Damage to nose landing gear.
- Bald spots on tires



Fig. 6



Fig. 7



Fig. 8

- Damaged of Nose Landing Gear Actuator.



Fig. 9



Fig. 10

- Damage to the Nose Gear Steering Assy.



Fig. 11



Fig. 12

- Dents in mid fuselage.



Fig. 13

- Dents in right Ailerons & Flaps



Fig.14

- Dents in left Ailerons & Flaps.



Fig. 15

Dents in Vertical Stabilizer, Rudder, Horizontal Stabilizer, Elevator



Fig. 16

2.4. Other damages

When leaving RWY, the aircraft caused damage to equipment of the airport's facilities as follows

- Broken RWY edge lamp from Runway lighting
- Broken and crushed electrical box of the MITRAS MID transmissometer from the VAISALA LT31 system, which provides power and communication with the middle anemometer WA MID.



Fig. 17

2.5. Personnel information:

2.5.1. Pilot in command

Man 47 years old
License: ATPL TR-A
Issued on 20.02.2008 by DG CAA Turkey
Valid until 30.04.2019
Qualifications: MEP (Land) IR C680.
Medical Validity: Class 1, valid to 13.11.2018
Medical restrictions: None.
Proficiency in English: English Level 6.
Flight experience:
Total Flying Hours (Pilot in Command, Co-Pilot, Pilot Under Training): 8106,45 FH.
Total Flying Hours on Type (Pilot in Command, Co-Pilot, Pilot Under Training): 130 FH
On the type of A/C as Captain: 130 FH.
Information on the working hours and rest:
For the last 24 hours: 0:00 flight hours (Last flight on 28.08.2018);
For the last 30 days: No information;
For the last 90 days: 101:00 flight hours.
Rest before the flight: 48 Hours (rest at the hotel in Bakü-Azerbaijan).
Aviation events until present: No information.
The Commission assumes that the captain has the necessary training and qualifications for his functional duties and that there is no breach of the rules on working time and pre-flight rest periods.

2.5.2. Co-pilot

Man 29 years old
License: CPL (A) TR-A
Issued on 22.04.2011 by DG CAA Turkey
Valid until 30.06.2019
Qualifications: MEP (Land) IR C680.
Medical Validity: Class 1, valid to 17.08.2019
Medical restrictions: None.
Proficiency in English: English Level 5, valid until 20.05.2019
Flight experience:
Total Flying Hours (Pilot in Command, Co-Pilot, Pilot under Training): 612:30 FH.
Total Flying Hours on Type (Pilot in Command, Co-Pilot, Pilot Under Training): 114:30 FH
Information on the working hours and rest:
For the last 24 hours: 0:00 flight hours (Last flight on 28.08.2018);
For the last 30 days: No information;
For the last 90 days: 114:30 flight hours.
Rest before the flight: 48 Hours (rest at the hotel in Bakü-Azerbaijan).
Aviation events until present: No information.
The Commission assumes that the co-pilot has the necessary training and qualifications for his functional duties and that there is no breach of the rules on working time and pre-flight rest periods.

The Commission is of the opinion that the flying time of the two pilots of the type of aircraft is relatively small

2.6. Aircraft Information

2.6.1. Airworthiness Information

Type: CESSNA C-680 SOVEREIGN;
Registration: TC-OYD;
Factory number: 680-0344;
Owner: BOYDAK HAVACILIK TASIMACILIK VE TIC.A.S.;

Manufacturer: CESSNA, USA;
Produced 2012
State of registry Turkey
Overhaul resource: Operated according to the approved Maintenance programme;
Total flown hours and cycles: 1640:00 hours and 1557 cycles to 31.08.2018 as per the Technical logbook before take-off from Baku;
Total resource: Operated according to the approved Maintenance programme;
Certificate of Registration: No. 2682, issued by Turkey DG CAA, 30.01.2017;
Certificate of Airworthiness: No. 2682, issued by Turkey DG CAA, 03.02.2014;
Certificate of Airworthiness validity check: No. 2682, issued by Turkey DG CAA, 19.01.2018 Valid until 25.01.2019

Engines:
Engines No1 left PW 306 C;
Factory number: CG 0707
Resource and service life: Operated according to the approved maintenance programme.
Total hours and cycles: 1492/1457
Engines No 2 right PW 306 C;
Factory number: CG 0708
Resource and service life: Operated according to the approved maintenance programme.
Total hours and cycles: 1492/1457

Before take-off from the Baku Airport, the PIC performed the pre-flight check and it was recorded in the technical logbook for the relevant date and time.

In accordance Maintenance document Cessna 680 maintenance manual REV 26 Jan 2018 approval ref. TR 145-053, location LTAC, certifying staff name - Stamp 4667, the aircraft was served the aircraft is serviced under contract by an organization for maintenance as per EASA PART 145 APPROVAL, "EMAIR Aviation incorporated".

The total fuel quantity after landing from a previous flight to Baku Airport, with which the crew accepted the aircraft before departure to Burgas was 4500 lbs according to the record in the TLB page page No 000656/31.08.2018.

At the Baku Airport, with 4500 lbs fuel left, 6300 lbs fuel was added, registered in TLB page No 000656/31.08.2018, i.e. the total fuel on board of the aircraft before departure was 10800 lbs.

According to reviewed documents, all aircraft systems and the engines were supplied with the required fuel, oil and hydraulic quantities, special liquids and gases for operating the flight and the aircraft departed from Baku Airport without any technical failures or defects.

The take-off mass and the balance of the aircraft for the last flight was within standards, and there were no remarks on the performance of all aircraft systems and engines in the process of taxiing, take off and throughout the flight. The parameters of engines and aircraft systems performance in the FDR correspond to the established limits.

The Committee assumes that the maintenance of the aircraft was done according to the established standards. The aircraft and all its systems had the required resources for performing the flight.

2.6.2. Aircraft characteristics

The Cessna Citation Sovereign (Model 680), serial No 680-0344, registration TC-OYD is business jet developed by Cessna, part of the Cessna Citation family.

- Powerplants : Two Pratt & Whitney Canada PW-306C turbopfans;
- Capacity: 2 pilots, typical seating for eight passengers in a double club arrangement, max seating for 12
- Length – 18, 87 m.
- Wing span – 19, 24 m.
- Height - 5, 85 m.

- Maximum Takeoff Weight – 13,743 kg.
- Empty weight:– 9,434 kg.
- Maximum Range– 5273 km;
- Maximum Cruise Speed 460 kts 852 km/h
- Maximum Operating Altitude – 14326 m.

2.6.3. Information on the used fuel.

By the recordings in the Technical Logbook page No. 000656, completed before the flight of the event, the aircraft has 10800 lbs of fuel, aviation kerosene JET A1.

The amount of fuel quantity, his type and quality are not relevant to the event.

2.7. Meteorological information

The meteorological observations of the actual weather at the Burgas airport are carried out by an automatic monitoring station.

The automated aerodrome meteorological station automatically performs remote measurement and processing of the following meteorological values for both directions of the runway: wind speed and direction, visibility (MOR), runway visual range (RVR), base of clouds, temperature and air humidity, atmospheric pressure, as well as automatic data processing of visual observations for cloudiness (clouds amount and shape) and other adjustments that can be manually entered. The results of the observations are given on the weather display. To ensure the airport minimum for approach and landing, automatic updating is done every minute for the current parameters – surface wind, visibility (minimum at the beginning, middle and end of the relevant runway), base of cloud, the temperature, the air humidity, and atmospheric pressure.

The Commission analyzed the following data related to the meteorological data at the airport during the occurrence: meteorological instruction, preflight meteo information received by the crew at the Baku airport, the actual weather, forecast, ATC explanations about the weather at the time of the occurrence, explanation by the PIC, explanation from the co-pilot of the aircraft, data from the FDR, the Certificate of suitability of the measuring meteorological equipment at Burgas Airport, manufacturer, warranty maintenance and the last check for accuracy of measurement of all parameters.

2.8. Navigation systems

All of the airport navigation light systems have worked normally during the aviation event without interruption and switching to backup power mode.

The Commission found that the navigation systems and the ATM facilities at the airport until, during and after the aviation event were operational, failures or back-up power supply did not occur.

The CESSNA CE-680 SOVEREIGN aircraft, with registration number TC-OYD is equipped with standard navigation equipment to perform an ILS approach on RWY04 at the Burgas Airport. By crew information and following the records in the technical logbook, the aircraft's navigation systems have worked normally under the technical requirements.

2.9. Communication systems

The air-ground radio communication between the flight crew and ATCO-Tower at LBBG was carried out at the frequency of 118,000 MHz.

Bilateral radio communication between the flight crew and ATCO-APP at LBBG was carried out at the frequency of 125,100 MHz.

The Bulgarian Air Traffic Services Authority provided a transcript of the radio-communication of Burgas-Tower, Burgas-APP at frequencies 118,000 MHz. and 125,100 MHz. After hearing the radio conversations at the work frequencies of Burgas-Tower and Burgas-APP, the Investigation Commission found that there had been no loss of radio communication and there had been no interruptions and disturbances of the radio broadcasting.

The records are attached to the investigation materials.

2.10. Aerodrome information

Aerodrome Location Indicator and Name – LBBG-BURGAS;
ARP coordinates and site at aerodrome - N42°34'13" E027°30'55", RWY centre;
Elevation - 135 ft. (44 m);
Designations / RWY 04/22 - MAG 040°/220°;
Dimensions of RWY (m) - 3200 x 45 m;

2.11. Flight recorders

2.11.1. FDR (Flight Data Recorder)

For the analysis are used decoded data by Flight Data Systems from flight data recorder (FDR) model: L3 p/n: 2100-2042-00 s/n: 000630205. The data is provided with a report Flight Data Recorder Readout Service Specialist Report Job ID JN43678/15.Sep. 2018.

Data file: TC-OYD_15092018_1002-e.fdr

The parameter analysis detects an error in parameter “magnetic heading” (parameter A0130_Heading_Deg). The parameter does not match with the actual magnetic heading of runway at the airport of departure and the airport of landing.

2.11.2. CVR (Cockpit Voice Recorder).

The Cockpit Voice Recorder (CVR) is Model L3 FA2100. A file 20092018_0743.cvr was submitted for analysis.

A two-hour record is available without anomalies and recorded speech on Channel 2 (First Officer), Channel 3 (Captain), and Channel 4 (Cockpit Area Microphone - CAM).

On channel 1 (3rd crew) there is no recorded sound, which is considered normal, because there was no one in this position.

Transcription of the record including landing at Burgas Airport was made.

Graph of flight parameters related to landing at Burgas Airport.(Fig.16)

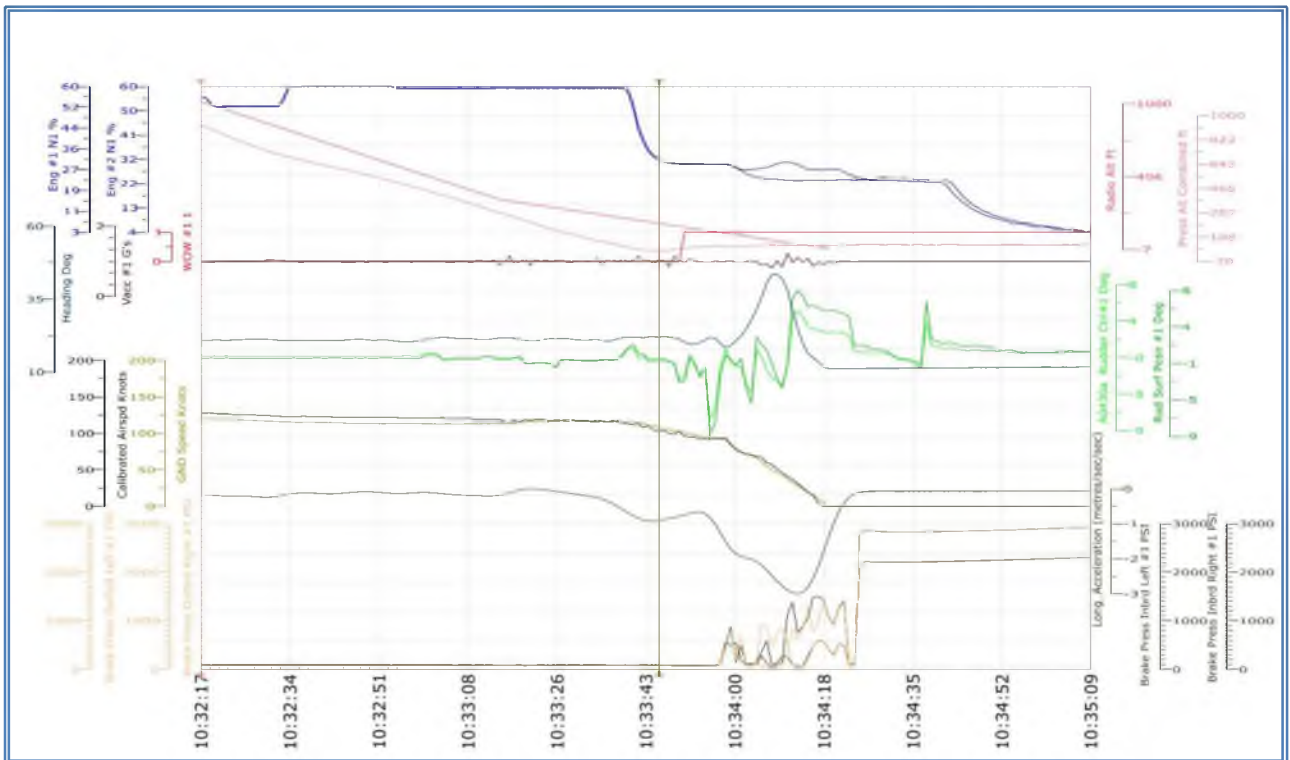


Fig.16

Graphics of flight parameters related to landing at Burgas Airport - Magnetic Heading, Rudder Control, Rudder Surface, and Weight on wheels. Fig.17

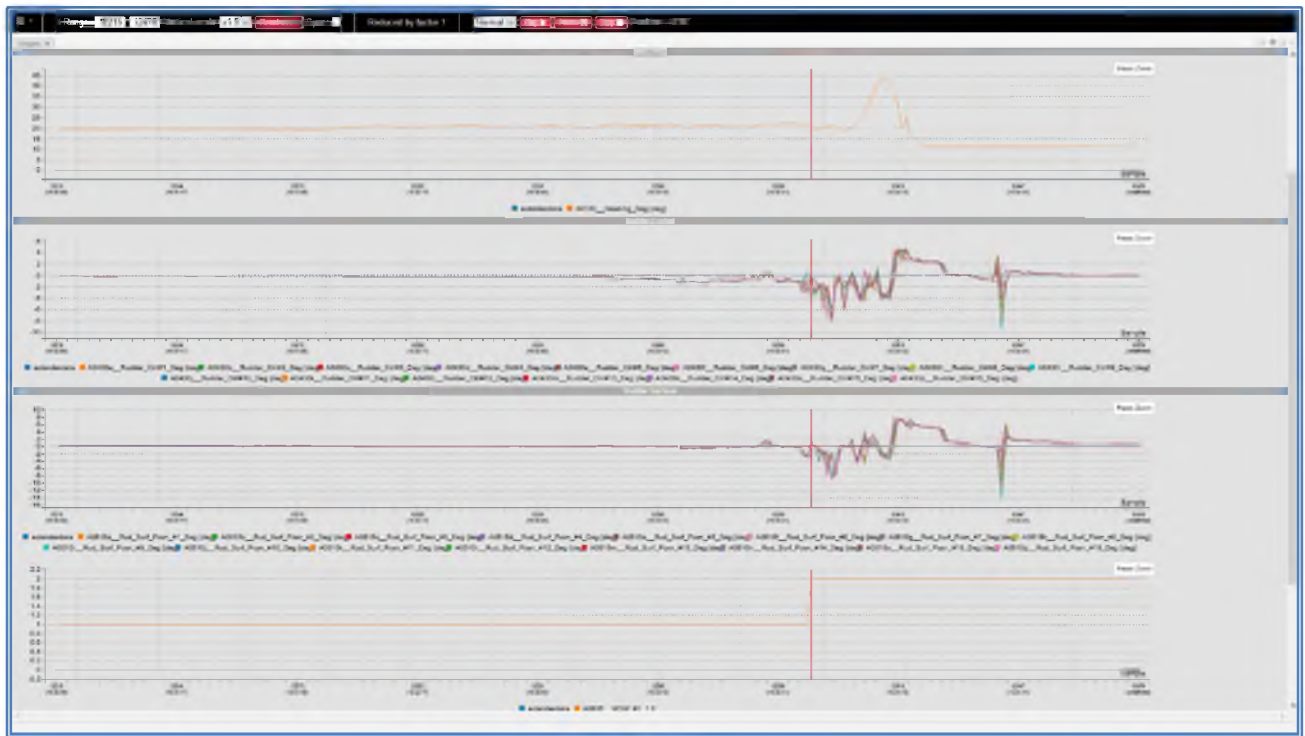


Fig.17

2.12. Information about the impact and the debris

The aircraft landed on RWY 04, the touchdown is at a point located 750 m from its threshold. The aircraft rolled 700 m and left the runway on the right. When leaving the aircraft, there was contact with a side lamp from the runway lighting and a power supply, communication box on the middle anemometer of the aero navigation equipment. The final stop was shortly after RWY centre at about 108 m to the side, at heading 32° and at a distance of 1650 m from its beginning. (Fig. 18)

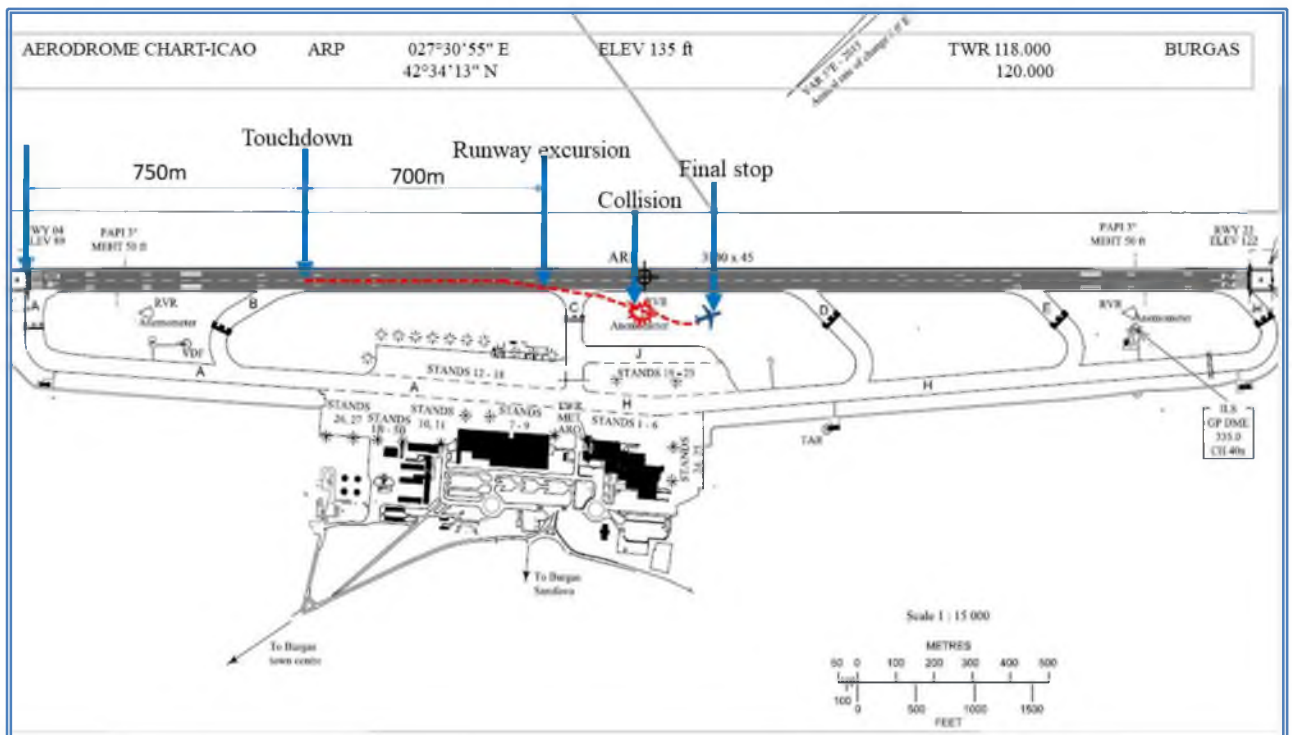


Fig. 18

The aircraft retained its structural integrity, on the runway there were only traces of brakes (Fig. 19). After the aircraft's full stop, an emergency rescue team arrived at the site, which measured, filmed and documented the occurrence, and then a crane moved the aircraft to the aircraft stand at the airport. The damages to the aircraft are described in paragraph 2.3.



Fig. 19

2.13. Medical and pathological information

There are no injuries and medical consequences for the crew as a result of the realized occurrence. Medical and pathological examinations are not performed.

2.14. Fire

The inspection did not determine a fire arising, however, Bourgas Airport has carried out for the worst consequences all available resources and equipment to extinguish a possible fire.

2.15. Factors for Survival

All available emergency rescue equipment at Bourgas Airport have carried out to the required readiness, but have not had to be activated and used.

2.16. Tests and research

For the safety investigation, the following activities were carried out:

1. Research of the written reports, given by the flight crew and ATCO.
2. Research and analysis of the operational documentation of the A/C;
3. Analysis of the aerodynamic characteristics and the performance of the aircraft;
4. Decoding and analysis of the FDR and CVR data;
5. Logical-probabilistic analysis of the possible causes for the realization of the aviation event.

For Item 1 research of the written reports, given by the flight crew and ATCO for occurrence are reflected in Para 2.1.2.

For Item 2, the results of the study and analysis of the operational documentations are reflected in Para 2.6.

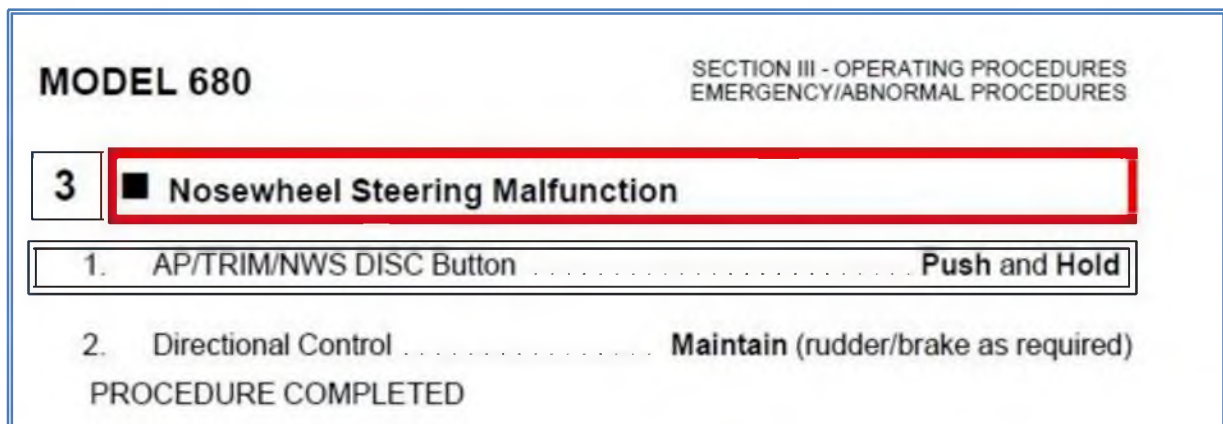
For Item 3, the results of the study and analysis of the aerodynamic characteristics and the performance of the aircraft are reflected in Para 2.6.1, 2.6.2 and 2.6.3.

For Item 3 the result of decoding and analysis of the FDR and CVR are reflected Para 2.1.2., 2.11. and 2.17

Logical and probabilistic analysis of the possible causes for the accident is given in Chapter 3 of this Report.

2.17. Flight Crew Operating Manual

2.17.1. Abnormal and Emergency Procedures – Nosewheel Steering Malfunction



2.17.2. Pilot's AP/TRIM/NWS DISC Switch – Operation

The pilot's and copilot's AP/TRIM/NWS DISC switches can be used to momentarily disengage nose wheel steering. Pushing and holding either switch applies a ground to the Landing Gear Logic Module. The logic module then applies bus voltage to energize the Power Steering Unit thereby, closing the shutoff valve and disengaging nose wheel steering.

2.17.3. “Memory items”

Memory items (alternately known as recall or immediate action items) may be described as ‘an action that must be taken in response to a non-routine event so quickly that reference to a checklist is not practical because of a potential loss of aircraft control, incapacitation of a crewmember, damage to or loss of an aircraft component or system, which would make continued safe flight improbable’ [FAA, 1995]. As such, in the event of an emergency situation arising, memory items should be accomplished from memory alone before the checklist is called for or read.

2.18. Additional Information

The transcript of conversations in the cockpit of the aircraft between the PIC and the co-pilot during of the occurrence.

At 10:33:55, the PIC: „It is deviating. Why this plane deviating? “

At 10:33:57, the Co-pilot: „We pressed left“.

At 10:34:03, the PIC: „, Something happened to that“.

At 10:34:15 the PIC: „,What happened? “.

At 10:34:16, the Co-pilot: „,Wheel is stuck“.

At 10:34:17, the PIC: „, Really? “.

At 10:34:18, the Co-pilot: „,Really stuck“.

At 10:34:19, the PIC: „,Nose landing gear is stuck, our landing gear is stuck Allah, Allah“).

At 10:34:31, the PIC „Something happened on nose landing gear“.

At 10:34:32, the Co-pilot: „Exactly my captain. We pressed left rudder pedal but it did not yaw“.

3. Analysis

In order to determine the causes of the aviation accident, the following aspects are considered:

1. Probable failure of operational units and systems of the aircraft;

It is clear from the CVR recording of the cockpit conversations between the pilots, quoted in paragraph 2.18 of this report, that they both observed the aircraft suddenly and spontaneously veering to the right and attempted to control it. It is evident from their comments and from the FDR recording analyzed that timely commands are given to maintain direction by the vertical rudder, ailerons, engine reversers and landing gear brakes, but as speed drops so does the effectiveness of the rudders, causing the aircraft to go off the runway edge. This led the Commission to accept the existence of a probable technical failure in the investigation of the aviation accident.

A technical failure in the nose wheel steering system is commented as probable because as a result of the impact of the nose gear into a concrete pedestal with aeronautical equipment, damage was caused to the nose gear itself, to its attachment assemblies and to its control systems, which do not allow an assessment of its condition before impact.

2. Sudden strong wind gust;

3. Presence of oil, fuel, water, dust or sand on the runway, making it difficult to control the aircraft during the landing.

The second and third aspects, such as a sudden strong wind gust or presence of oil, fuel, water, dust or sand on the runway, making it difficult to control the aircraft during the landing, were rejected by the Commission from the meteorological data provided at the time of the aircraft landing and the inspection of the runway immediately after landing.

4. Loss of working capacity due to a sudden deterioration of health in one or both of the pilots; The Commission also considered the loss of working capacity due to a sudden deterioration of health in one or both of the pilots, according to the pilots' explanations and according to information from Burgas Airport staff, both were in good health.

5. Errors made by the crew in the aircraft control and/or failure to follow prescribed procedures in the flight operational manual.

The Commission focused its attention on analyzing the steering of the nose wheel.

The aircraft touched down on the runway at 10:33:48 and the aircraft had no deviation from the centre line of RWY 04. The landing was performed by the co-pilot and with CAS = 100 kt and vertical acceleration $V_{acc} = 1.31g$. Wind speed at this time is 8.8 kt / 124°. Rudder deflection pedal force: Rud Force Pilot L Outbd 37.62 Lb. Rudder deflection command for direction: Rudder Ctrl -3.1 Deg. Rud Rudder deflection for direction: Rud Surf Posn #1-8 Deg -2.74 Roll: Roll Att #1 Deg -3.2

At 10:33:51 h, at Airspeed CAS 95 Kts, GND Sped 95 Kts, Track Angle 043 Degr., Heading 021 Degr., Roll Att #1 -2.1 Degr (Roll < 0 Left wing down) and Rud Surf Posn #1 rudder deflection - 8, Deg 0. 73 (Rudder < 0 Rudder to left, aircraft turns left) the aircraft still has rudder effectiveness and is taxiing normally on the centerline of Runway 04, and at 10:33:53 h the Speed Brake control lever

is moved (Speed Brake) is deflected 5 seconds after touchdown, and the deflection degrees (Spdbrk Lever #1/#2) are 1.3; 2; 1.4; 1.4 %, which do not correspond to the expected maximum lever deflections of 57° and we have now increase in Roll Att #1 - 3.49 Deg, (Roll < 0 Left wing down) and Rud Surf Posn #1 -8- 4.1 Deg rudder deflection, (Rudder < 0 Rudder to left, aircraft turns left).

Registered speed brake lever position (Spdbrk Lever # 1 / # 2) are respectively: 1.3; 2; 1.4; 1.4 %. The recorded values do not correspond to the expected maximum deviations of the lever - 57°.

At 10:33:56 h airspeed slowly decreases and the Roll Att #1 Deg -3.6, (Roll < 0 Left wing down), rudder deflection increases further to Rud Surf Posn #1 Deg -8.1, (Rudder < 0, Rudder to left, aircraft turns left).

At 10:33:57 h, left and right brakes were activated for the first time on the Commander's side. This begs the question: why, at this rudder deflection 9 seconds after touchdown, do we not have a more active, timely split brake application (only the left brake is at increasing pressure).

At 10:34:00, a Thrust Reverser Left and Right Unlocked was detected on Engine No. 1 and Engine No. 2, i.e. 12 seconds after the touchdown and at 10:34:01 h is recorded an operation of the reverse thrust of Engine 1 and Engine 2(T/R Deploy) and activation of left and right brakes by Captain and First officer - GND Speed Knots 76.5

At 10:34:04 h, the aircraft starts to change course to the right, GND Speed 69,5 Kts, Track Angle 070 Deg, Heading 035 Deg, Rudder Roll Att #1 - 3,69 Deg, (Roll < 0 Left wing down), Rudder Rud Surf Posn #1 - 5. Deg, (Rudder < 0, Rudder to left, aircraft turns left).

At 10:34:05 the FDR registers only the left brake application on the co-pilot side (for the first time) and after that the left and right (for the third time) brake application by both the commander and the co-pilot simultaneously, with fluctuating pressure of the four brakes.

At 10:34:07 h the aircraft left RWY 04 at a distance of 1480 m from its threshold at GND Speed 61.3 Kts.

Outside the runway, the situation became fatal for the aircraft due to an accidental collision with a concrete pedestal of a power communication box of the middle transmission of the aeronautical equipment, 15 sm. high and 1 x 1 m in size. From the grass area of the entire free field of the aerodrome there is only one technical means with a height of 15 sm. above the ground and the aircraft goes right into it.

Based on the data of the flight information carriers CVR and FDR, the situation of the aviation occurrence was revealed to the Commission: 'We pressed left. Something happened to that', and the crew was convinced that something was wrong. According to the FDR data, there are commands recorded that do not match the aircraft trajectory, i.e. the crew's claims of a probable technical failure of the nose wheel control system are correct.

The Commission accepted as uncontroverted the FDR data and the crew's statements. The fact of the simultaneous application of the left and right brakes recorded by the FDR is confirmed by the runway tracks.

After the Commission accepted, with the facts thus stated from the readings of the parameters recorded by the flight data carriers and the statement of the crew, the leading hypothesis of an objective cause - a probable technical malfunction, the question arose about the actions of the crew

in the emergency situation thus arising, as a subjective cause for the realization of the aviation occurrence.

An emergency situation occurred - probable nose wheel steering failure, the crew realized the cause of the deviation to the right but did not take the maximum possible adequate action.

The question that should be answered here is: why didn't the crew take the maximum possible adequate action in those 19 seconds from touchdown to leaving the runway, after realizing that "something was going on with this", (that the nose wheel controls were not responding to the commands given) to allow the aircraft to exit the runway.

The crew was late in deploying the spoilers and did not move them to their maximum possible position, which delayed the reduction in speed after the touchdown.

As noted above at 10:33:53 h., the moment when the commander was taking control – the spoilers control lever was deflected. The spoilers' lever positions (Spdbrk Lever # 1 / # 2) are registered respectively: 1.3; 2; 1.4; 1.4 %. The recorded values do not correspond to the expected maximum deviations of the lever - 57° and at 10:34:01, i.e. 13 seconds after the touchdown, the reverse thrust of Engine 1 and Engine 2 was engaged.

The spoilers did not reach their maximum deflection and this contributed to the fatal accidental impact with the transmission out of Runway.

It should be noted that the flight crew is late in engaging the engine reverse thrust, which also delayed the speed reduction, and did not register maximum right brake activity.

As mentioned above in paragraph 2.17 of this report, the immediate action to be taken by the flight crew in response to situations in which the safety of the aircraft has been compromised was described. The situation was critical in a time deficit. In the event of an emergency situation a set of specific actions, appropriate to the nature of the event, are required to be performed by the crew before they make reference to the QRH. These actions, known as memory items (or recall/immediate action items), are committed to memory by each pilot as part of the training programme for each particular aircraft type and should be performed in response to the emergency situation immediately.

There was no evidence from the FDR that the crew completed Abnormal and Emergency Procedures - Nosewheel Steering Malfunction from the FCOM, and it was also not evident from the conversation between the two pilots in the cabin. Neither the pilot in command nor the co-pilot commented the momentarily disengage nose wheel steering with the trim disconnect switch on the pilot's control wheels.

It should be noted that the flight crew failed to perform the prescribed procedure "Abnormal and Emergency Procedures - Nosewheel Steering Malfunction" by their aviation operators in case of failure of Nosewheel Steering System.

Spoilers in maximum position, immediate the engine reverse thrust, differential braking and the execution of the prescribed procedure in the FCOM mentioned in paragraph 2.17 of the report in case of probable Nosewheel Steering Malfunction - these are the necessary actions of the commander, which in their combination and sequence could have prevented the aircraft from leaving Runway 04 and the accidental coincidence of the collision with the concrete obstacle at Burgas Airport.

In view of the above, it is concluded that the accident under investigation is most probably a result of the following cause:

Probable technical failure of the nose wheel steering of the aircraft after touchdown and the following errors made by the flight crew during the roll phase after landing at Burgas airport:

- Not deploying spoilers to maximum position;
- Delayed in engaging reverse thrust of both engines;
- Ineffective differential braking;
- Failure to perform the emergency procedure prescribed in the FCOM in the case of malfunction of the nose wheel steering system.

4. Conclusion

4.1. Findings

As result of the investigation, the Commission made the following conclusions:

1. The Aircraft CESSNA C-680 SOVEREIGN, serial number No. 680-0344, registration TC-OYD was manufactured in year 2012, manufacturer CESSNA USA.
2. The aircraft has Registration Certificate No 2682, issued on 30.01.2017 by the DG CAA of the Republic of Turkey.
3. The aircraft has a Certificate of Airworthiness No 2682, issued on 03.02.2014 by the DG CAA of the Republic of Turkey.
4. Airworthiness review certificate of the aircraft No 2682 has been issued on 03.04.2014 by the DG CAA of the Republic of Turkey and is valid until 25.01.2019.
5. The aircraft has flown 1640 flight hours and 1557 cycles since new.
6. The flight crew of aircraft CESSNA C-680, Commander and Co-pilot possess the required qualification and medical fitness for flights in accordance with existing regulations, but the flight hours of the type of aircraft are relatively small;
7. A DAILY CHECK of the aircraft was performed before the flight, in which the occurrence was realized. No failures and deficiencies were established during the inspection.
8. The maximum take-off mass of the airplane is 13743 kg. Empty mass of the aircraft is 9434 kg.
9. At take off from Baku Airport, in accordance to the loadsheet, the take-off mass of the aircraft and the balance was within the permissible limits.
10. The damages to the aircraft are described in paragraph 2.3, are result of crushed in a side lamp from the runway lighting and power supply of communication box on the middle transmissometer of the aero navigation equipment.
11. The flight planned in accordance with the procedures of the aviation operator.
12. The flight was for relocation from Baku to Burgas.
13. There had been no loss of radio communication between the flight crew and ATC services on the route, at the landing approach phase and landing.
14. The flight crew made a mistake during the roll phase after landing at Burgas airport, consisting:
 - Not deploying spoilers to maximum position;
 - Delayed in engaging reverse thrust of both engines;
 - Ineffective differential braking;
 - Failure to perform the emergency procedure prescribed in the FCOM in the case of malfunction of the nose wheel steering system.
15. The accident was realized during landing on RWY 04 at Burgas airport during daylight hours.
16. The aircraft touched down on RWY 04 at a point located 750 m from its threshold with CAS = 100 kt.

17. The aircraft left the RWY04 on the right at a distance of 1480 m from its threshold with the ground speed of 61,3 kts
18. The aircraft is completely stopped about 108 m southeast from RWY centre, at heading 32, at a distance of 1650 m from RWY04 threshold.
19. The flight crew left the aircraft alone without injury.
20. There is no evidence that physiological factors or loss of ability have affected the crew's operational capability.
21. The ATCO Tower warned by timely the operational centre of Burgas airport of the runway excursion.
22. The supervisor of operational centre of Burgas airport announced a timely "Alert"
23. The emergency and rescue teams was completed and acted in accordance with the Plan of Rescue and Fire Fighting activities on the airfield at Burgas airport.
24. The Aircraft CESSNA C-680 SOVEREIGN, serial number No. 680-0344, registration TC-OYD is equipped with Cockpit Voice Recorder model L3 FA2100 PNM № 266-E-5542-00 and Flight Data Recorder model FA2100 s/n: № 000630205.
25. The data from FDR and CVR recorders for the flight TCOYD were decoding and using during the investigation.
26. The use of CVR and FDR data allowed to clarify the flight parameters at the landing phase at Burgas airport.

4.2. Causes

On the grounds of the analysis made the Commission points out that the accident is most probably a result of the following cause:

Probable technical failure of the nose wheel steering of the aircraft after touchdown and the following errors made by the flight crew during the roll phase after landing at Burgas airport:

- Not deploying spoilers to maximum position;
- Delayed in engaging reverse thrust of both engines;
- Ineffective differential braking;
- Failure to perform the emergency procedure prescribed in the FCOM in the case of malfunction of the nose wheel steering system.

5. Safety Recommendations

Taking into account the causes of the accident and the deficiencies found in the investigation, the Commission recommends that the following measures should be taken to ensure the flight safety:

BG.SIA-2018/14/01. The Aviation Operator „BOYDAK AIR“ to include in the crew training program a simulator training exercise for the crews of the CESSNA C-680 SOVEREIGN aircraft, which would simulate the situation arising from the accident.

On the grounds of Article 18, §5 of Regulation (EU) 996/2010, the safety recommendation issued will be recorded in the centralized European system SRIS (Safety Recommendations Information System).

The Investigation Commission reminds all organizations, to which flight safety recommendations are sent that, on the grounds of Article 18 of Regulation (EU) 996/2010 on Investigation and Prevention of Accidents and Incidents in Civil Aviation and Article 19, paragraph 7 of Ordinance No. 13 on the Investigation of Aviation Accidents are obliged to notify the Air, Maritime and Railway Accidents Investigation National Board in writing of the action taken on the recommendations made.

COMMISSION ON INVESTIGATION OF ACCIDENT
28 December 2022



Flight Data Recorder Factual Report
TC-OYD-20180831

Aero Technic BG
Sofia, Bulgaria 1540, Sofia Flight Training Ltd, office No8
E-mail: management@aerotechnic-bg.com
<https://www.aerotechnic-bg.com/>

ANNEX 1

FLIGHT DATA RECORDER FACTUAL REPORT

TC-OYD-31 AUGUST 2018 FOR AIR, MARITIME AND RAILWAY ACCIDENTS INVESTIGATION NATIONAL BOARD

management@aerotechnic-bg.com

	Flight Data Recorder Factual Report TC-OYD-20180831	Aero Technic BG Sofia, Bulgaria 1540, Sofia Flight Training Ltd, office No8 E-mail: management@aerotechnic-bg.com https://www.aerotechnic-bg.com/
--	--	--

1. Event Summary

Event: RWY 04 excursion after landing

Location: BOY

Date: 31.08.2018

Aircraft: TC-OYD Cessna 680 Citation Sovereign

Operator: BOYDAK AIR

2. Recorder Description:

For the analysis are used decoded data by Flight Data Systems from flight data recorder (FDR) model: L3 p/n: 2100-2042-00 s/n: 000630205. The data is provided with a report Flight Data Recorder Readout Service Specialist Report Job ID JN43678/15. Sep. 2018.

Data file: TC-OYD_15092018_1002-e.fdr, TC-OYD CSV Parameter Listing.csv

The CSV exported file is at the maximum rate of 1 subframe per second.

If any parameters are recorded more than once per second they reflected in the .CSV data as separate columns.

The following faults were observed in Flight Data Systems report with the recorded parameters:

(A0400a - A0400h) Aileron LH #1 - Aileron LH #8 - Offset 7° In Cruise

The parameter analysis detects an error in parameter “**magnetic heading**” (parameter **A0130_Heading_Deg**). The parameter does not match with the actual magnetic heading of runway at the airport of departure and the airport of landing.

Spoilr Posn parameters (A0620_Spoilr_Posn_L_#1, A0625__ Spoilr_Posn_L_#2, _ Spoilr_Posn_R_#1, _ Spoilr_Posn_R_2) are in a "valid" position for the entire flight, which requires further clarification of their interpretation.

During flight data analysis following directions are used as a reference, based on directions clarification email from FDS. Flight Data Systems. PTY. Ltd email from Monday, January 25, 2021 6:53 AM

Roll >0 left or right wing down?: Roll >0 = Right wing down

Pitch >0 : nose up or nose down?: Pitch >0 = Nose up

Lat Acc >0 : right side or left side slip?: Lat Acc >0 = Left side slip (Heading > Track)

Elevator >0 : pitch surface up or down?: Elevator >0 = Pitch surface up

Aileron >0 : aileron up or down?: Aileron >0 = Aileron up

Rudder >0 : rudder to left or rudder to right?: Rudder >0 = Rudder to right (aircraft turns right)

Pitch control pilot A0250 parameter is negative for a pitch up, negative means the pilot is pulling the controls towards him such as at take off.



3. Recorder condition

Provided data is good. Data quality report was generated by FDS

Data Quality Report					
Aircraft: Cessna 680					
File Name: TC-OYD_15092018_1002.bin					
Data Time: 176:08:16					
Printed: 24 September 2018 12:23:18					
SF	Bad Data	%	No Data	%	Subframes
1	666	0.4	20	0.0	158524
2	422	0.3	308	0.2	158524
3	363	0.2	403	0.3	158524
4	327	0.2	479	0.3	158524
	1778	0.3	1210	0.2	634096

4. Timing and Correlation

Timing on the transcript was established by correlating the CVR events to common events on the flight data recorder (FDR).

For time reference are used following recorded parameters:

Hours: 1990_HH_Hrs

Minutes: A1995_MM_Min

Seconds: A2000_SS_Sec

Relative Time



All times in Coordinated Universal Time (UTC)

5. Sequence of events

07:07:27 the record from FDR on aircraft TC-OYD for flight GYD - BOJ from date 31.08.2018 start.

07:18:10 Start of engine #2. Anomalies of engine parameters not observed.

07:20:25 Start of engine #1. Anomalies of engine parameters not observed.

07:22:10 Start taxiing from Baku Heydar Aliyev International Airport (GYD/UBBB).



7:23:16 Flaps set to 7°.



The taxiing is performed at an initial speed of 10 Kt, then at an average speed of 20 kt. No detected anomalies in the engine's parameters during the taxiing. The average fuel flow is accordingly Eng #1 FF – 230 lbs/h; Eng #2 FF – 285 lbs/h.

07:30:02 Take-off from Baku Heydar Aliyev (GYD / UBBB) from RUNWAY 17 with flaps set at 7° and fuel quantity - Fuel Qty 10723 Lbs.

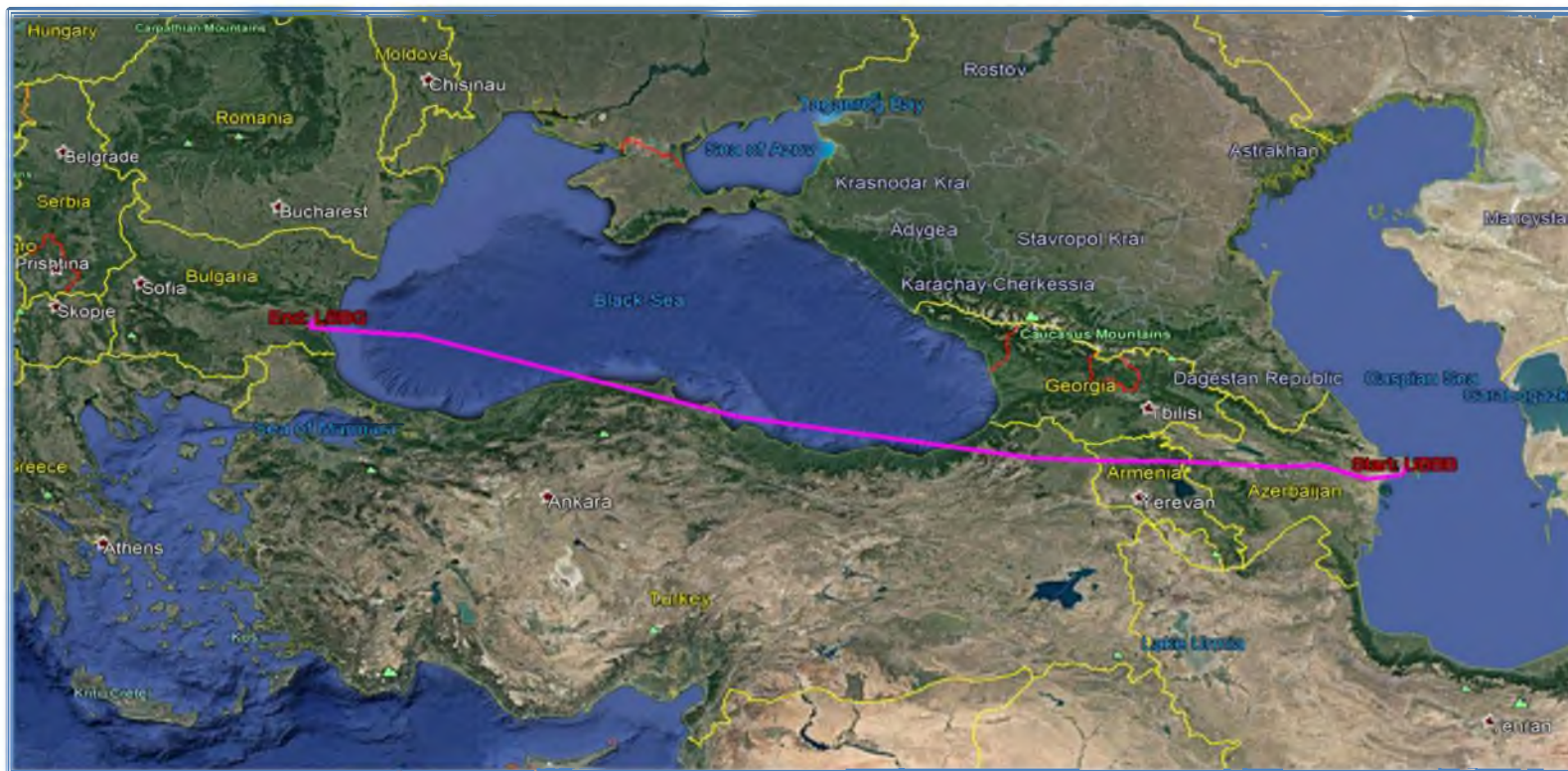
The wind speed at this moment is 2.4 kt / 70°.

All gears are retracted at altitude - Radio Alt = 202 ft.

Flaps are set to 0° at altitude Radio Alt = 1382 ft the position.

Autopilot is engaged at height Press Alt 12112 ft.

There are no anomalies in engine parameters during departure and initial climb. The flight to Bourgas (LBBG) is performed normally, without deviations, in transition levels FL 400 and FL 430.





09:57:24 the aircraft start approach with calibrated speed - Calibrated Airspeed 206 kt and average vertical speed 1000ft/min.

Twice, at 10:08:53 and at 10:18:13 for about 10 seconds, the vertical speed reaches 6000ft/min.

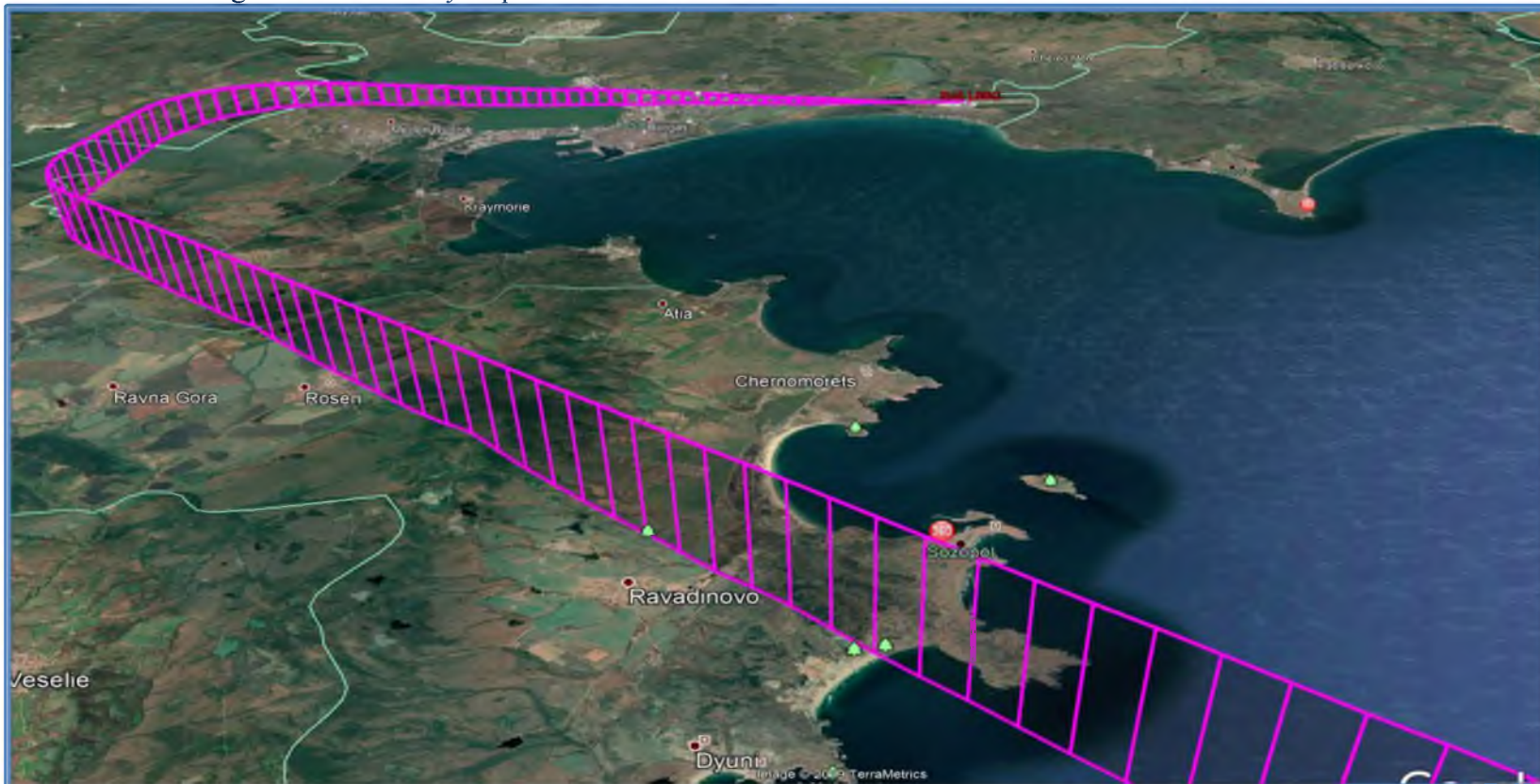
10:29:01 On barometric altitude - Press_Alt = 3500 ft and speed - Calibrated_Aispd = 198 kt. flaps are set to 7°.

10:31:50 On radio altitude - Radio Alt = 1244 ft and speed - Calibrated_Aispd = 151 kt. flaps are set on 35°.

10:31:22 Autopilot is disengaged

10:31:37 Landing gears are extended. Radio Alt 1596 ft, Airspeed Calibrated_Aispd = 153 kt. The airplane is in full landing configuration and prepared for landing.

10:33:09 Reached decision height of 428 ft set by Captain and First officer.

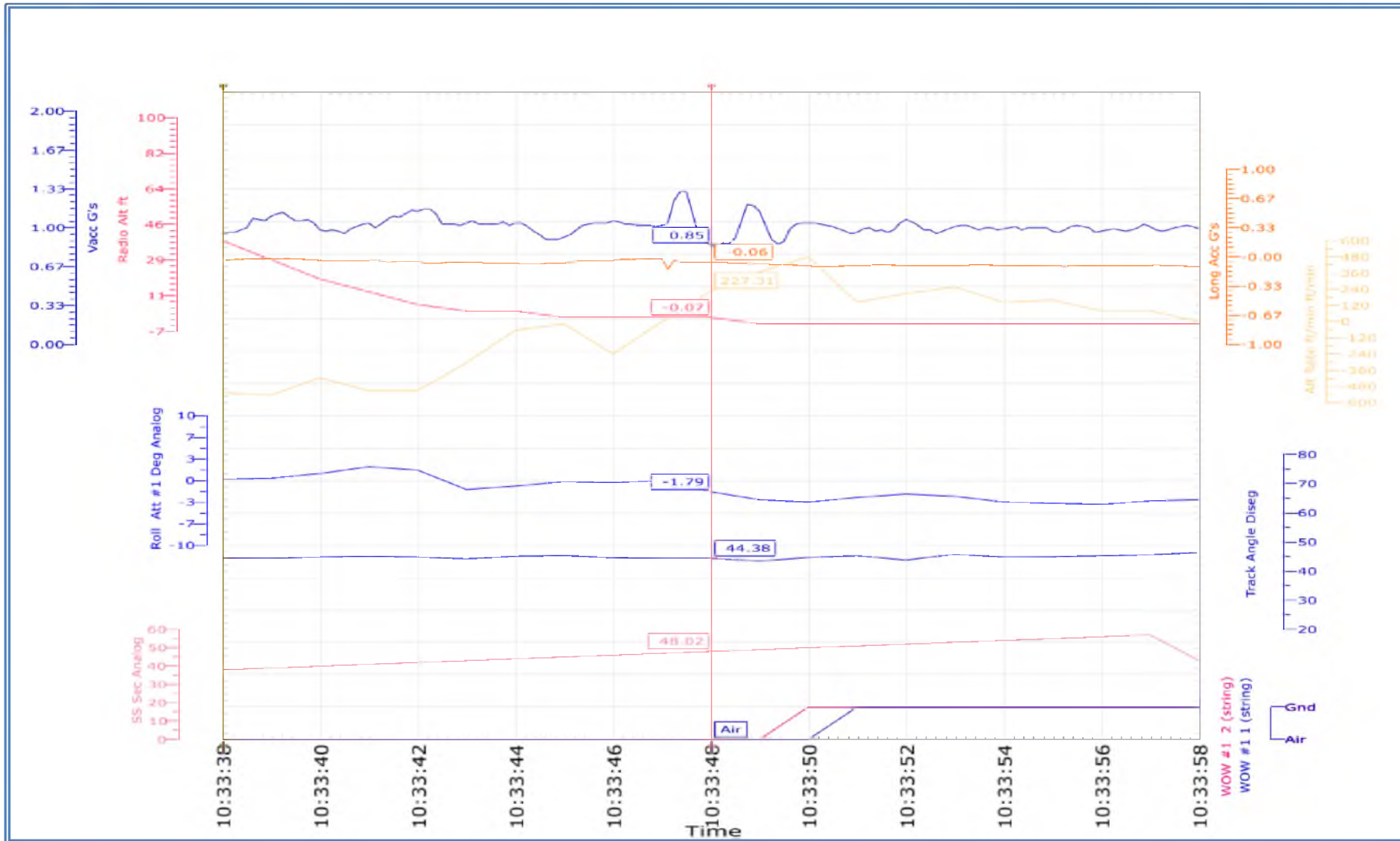








10:33:48 The touch down point is detected at radio altitude, vertical acceleration and change of the sign of the vertical speed







10:33:50 Landed at BOJ Airport at runway 04 with CAS = 100 kt and vertical acceleration Vacc = 1.31g. Wind speed at this time is 8.8 kt / 124°. A second later, the signal of weight on wheel (WOW) was triggered. WOW #1 1, WOW #2 1 triggered a half second later. Engines parameters during touch-down are:

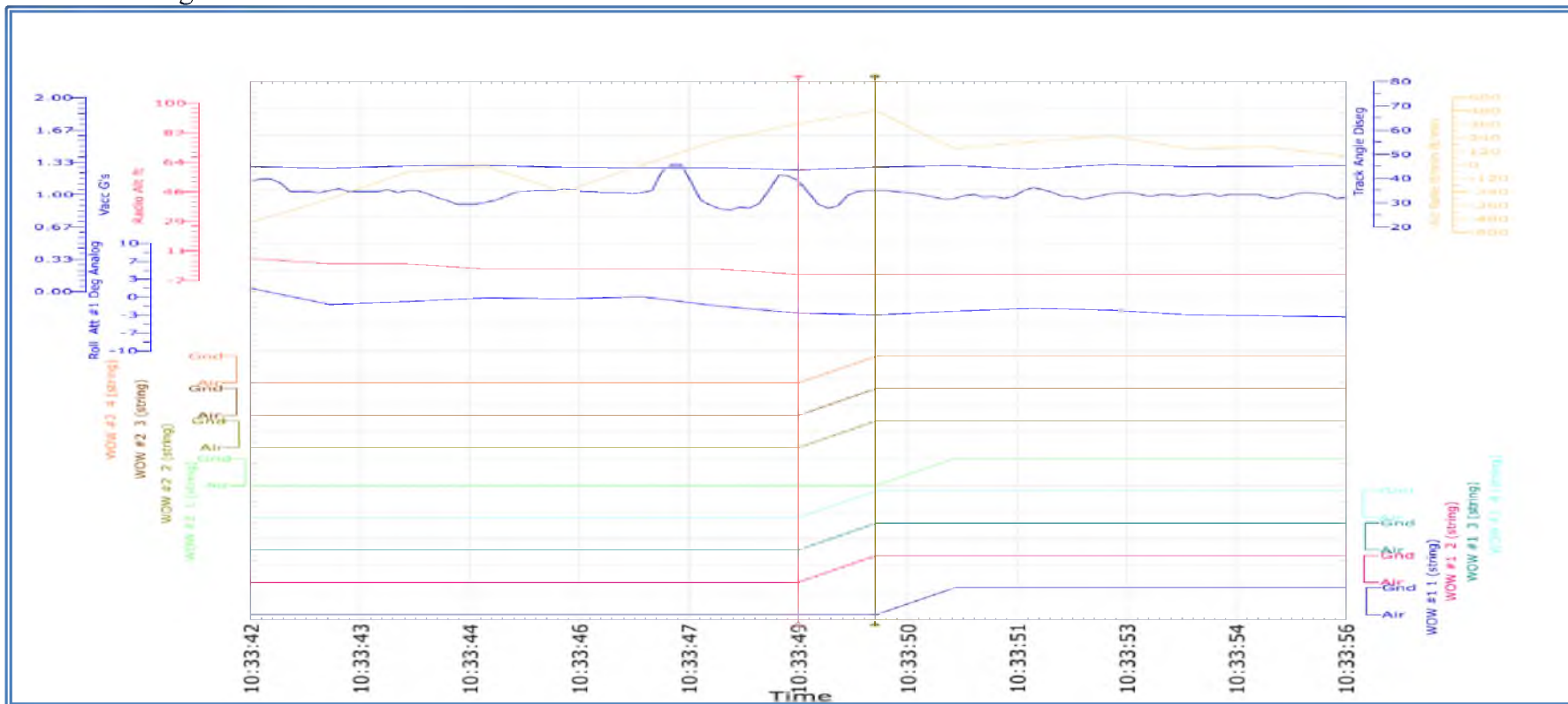
-	Engine 1	Engine 2
N1	30,3 %	30,3 %
N2	69 %	68,6 %

Rud Force Pilot L Outbd 37.62 Lb

Rudder Ctrl -3.1 Deg.

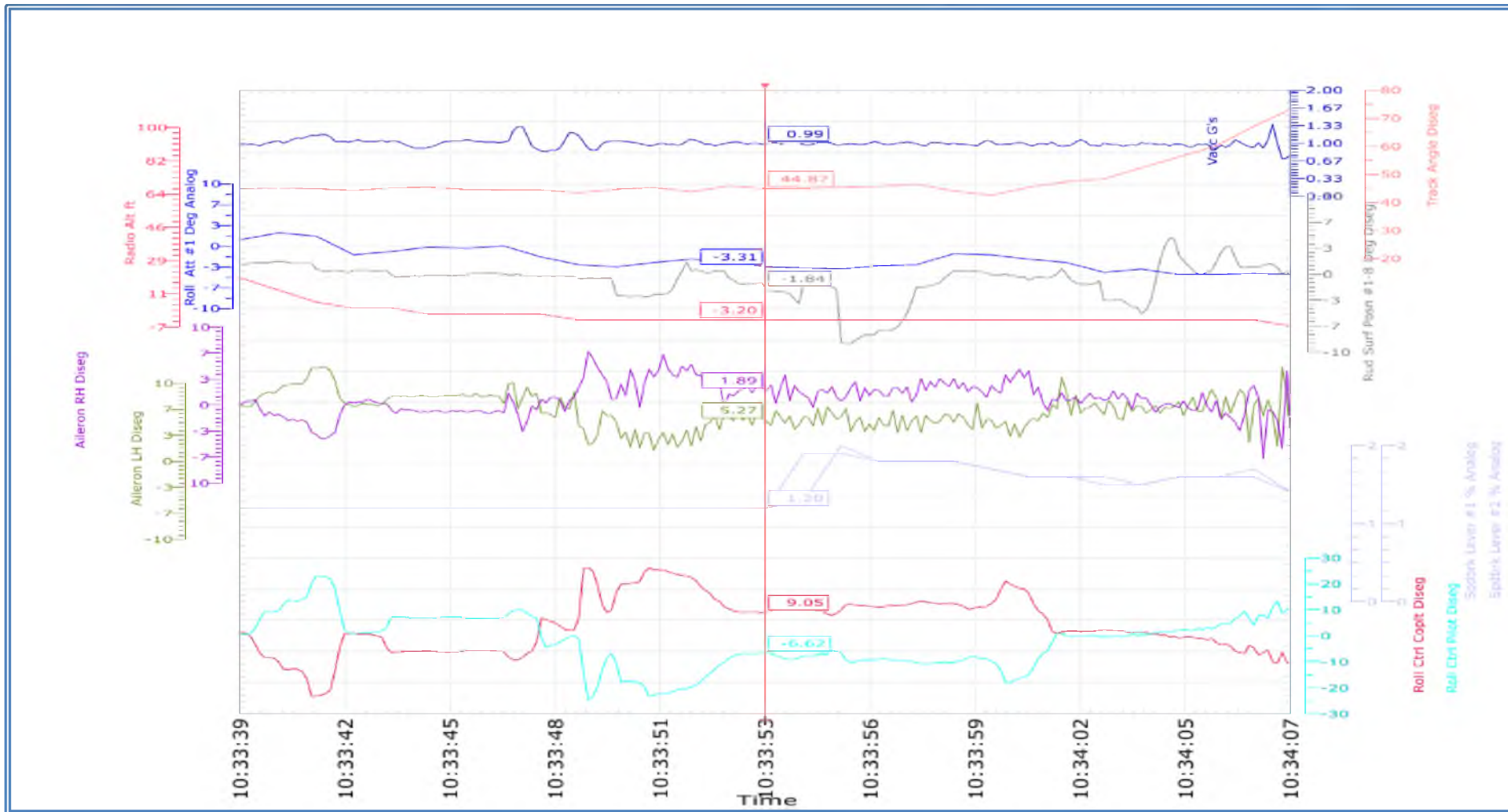
Rud Surf Posn #1-8 Deg -2.74

Roll Att #1 Deg -3.2





10:33:53 Speed Brake control lever is moved. Registered speed brake lever position (Spdbrk Lever # 1 / # 2) are respectively: 1.3; 2; 1.4; 1.4 %. The recorded values do not correspond to the expected maximum deviations of the lever - 57°.



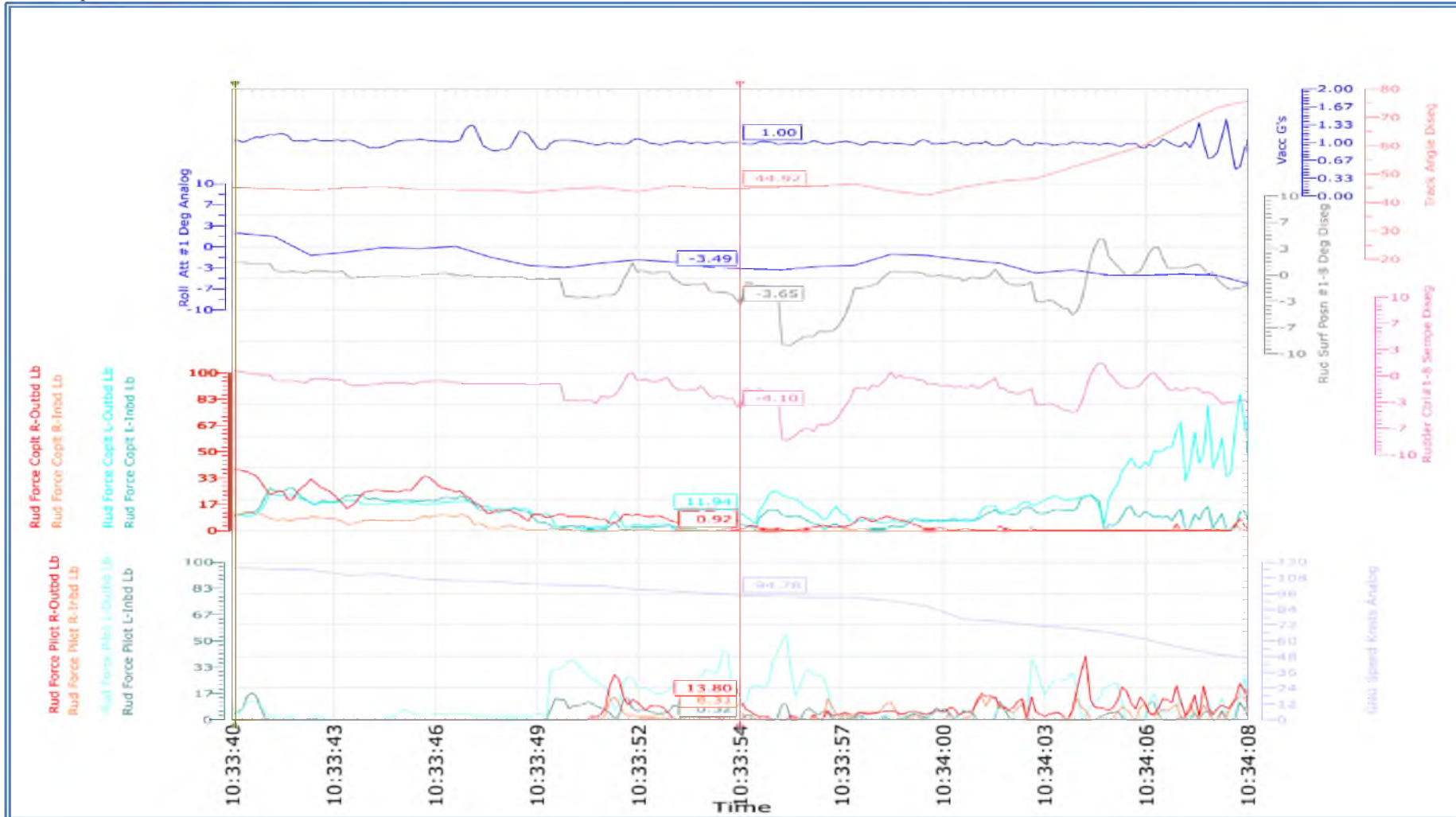


10:33:54

Roll Att #1 Deg -3.49

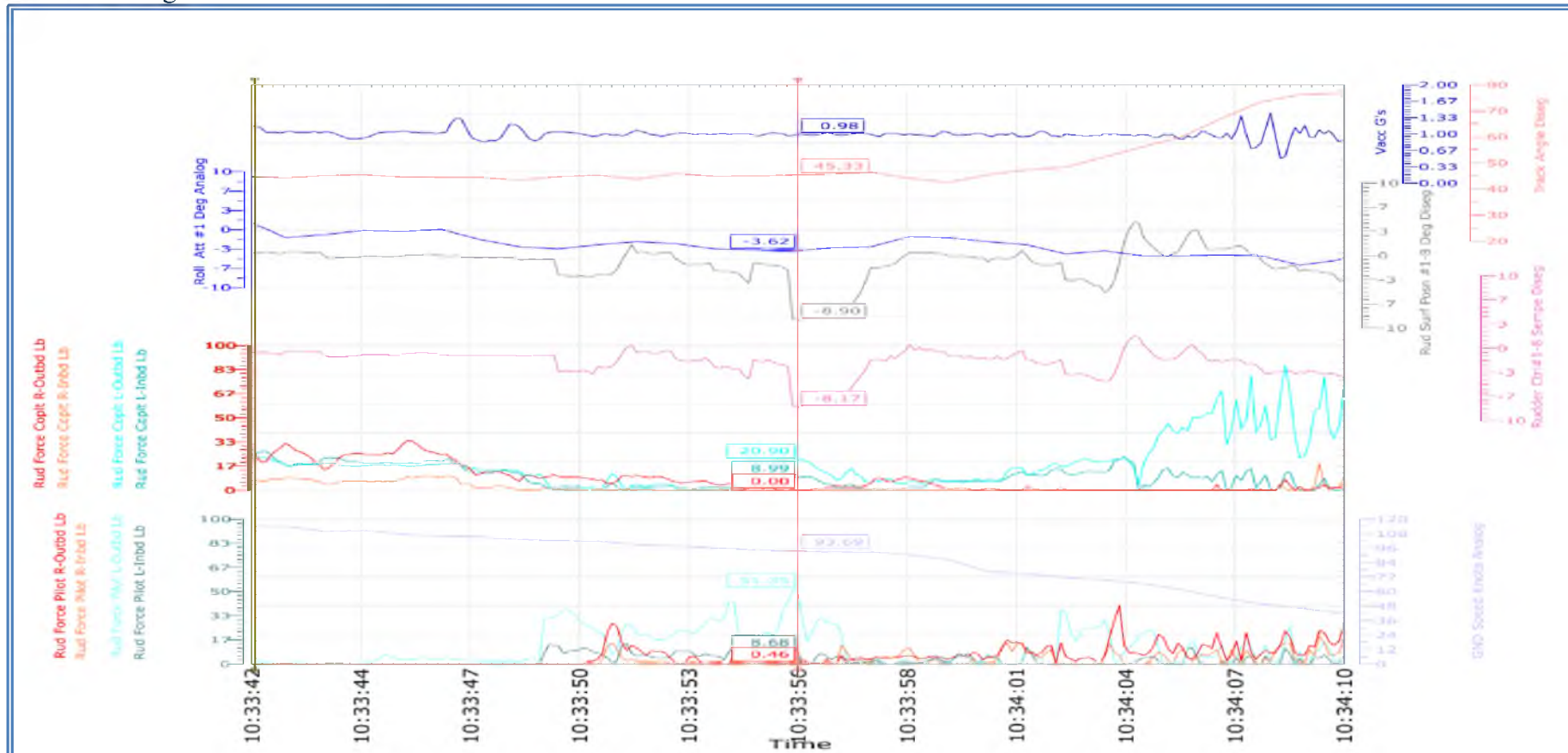
Rud Surf Posn #1-8 Deg -4.1

GND Speed Knots 95





10:33:56 Rudder control command at -8.1 degrees from Pilot L and Rudder deflection of -8.9 degrees. Rudder Command comes from Pilot Side (Captain)
Rudder Ctrl -8.1 deg
Rud Surf Posn -8.9 deg
Roll Att #1 Deg -3.6
GND Speed Knots 93.7
Rud Force Pilot L-Outbd 51.35 Lb
Rud Force Coptl L-Outbd 20.9 Lb
Lat Acc: 0.17 g







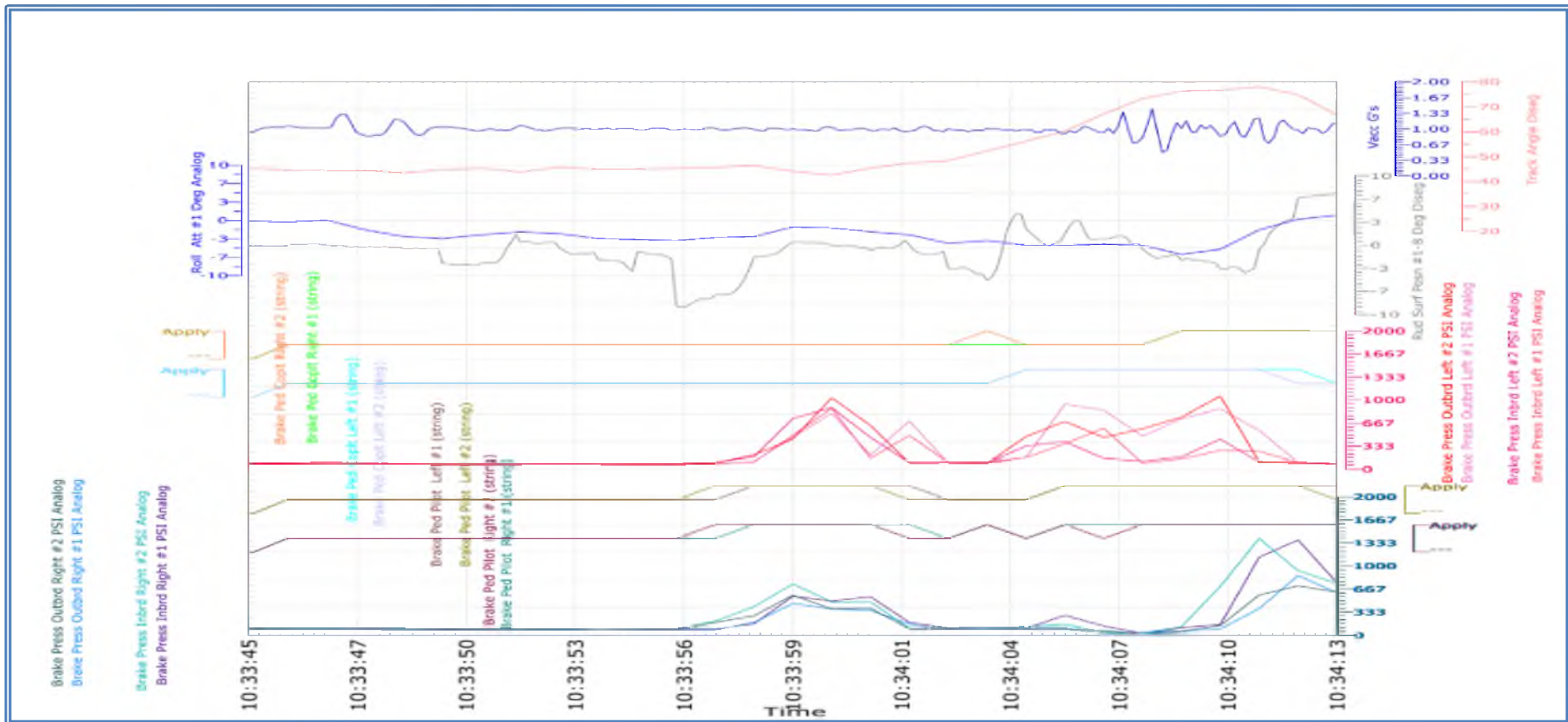
10:33:57 Simultaneous operation of left and right brakes on the Captain's side. Higher pressure on the left brakes.

Brake Ped Pilot Left #1, #2 "Apply"

Brake Ped Pilot Right #1, #2 "Apply"

GND Spd 93 Kts

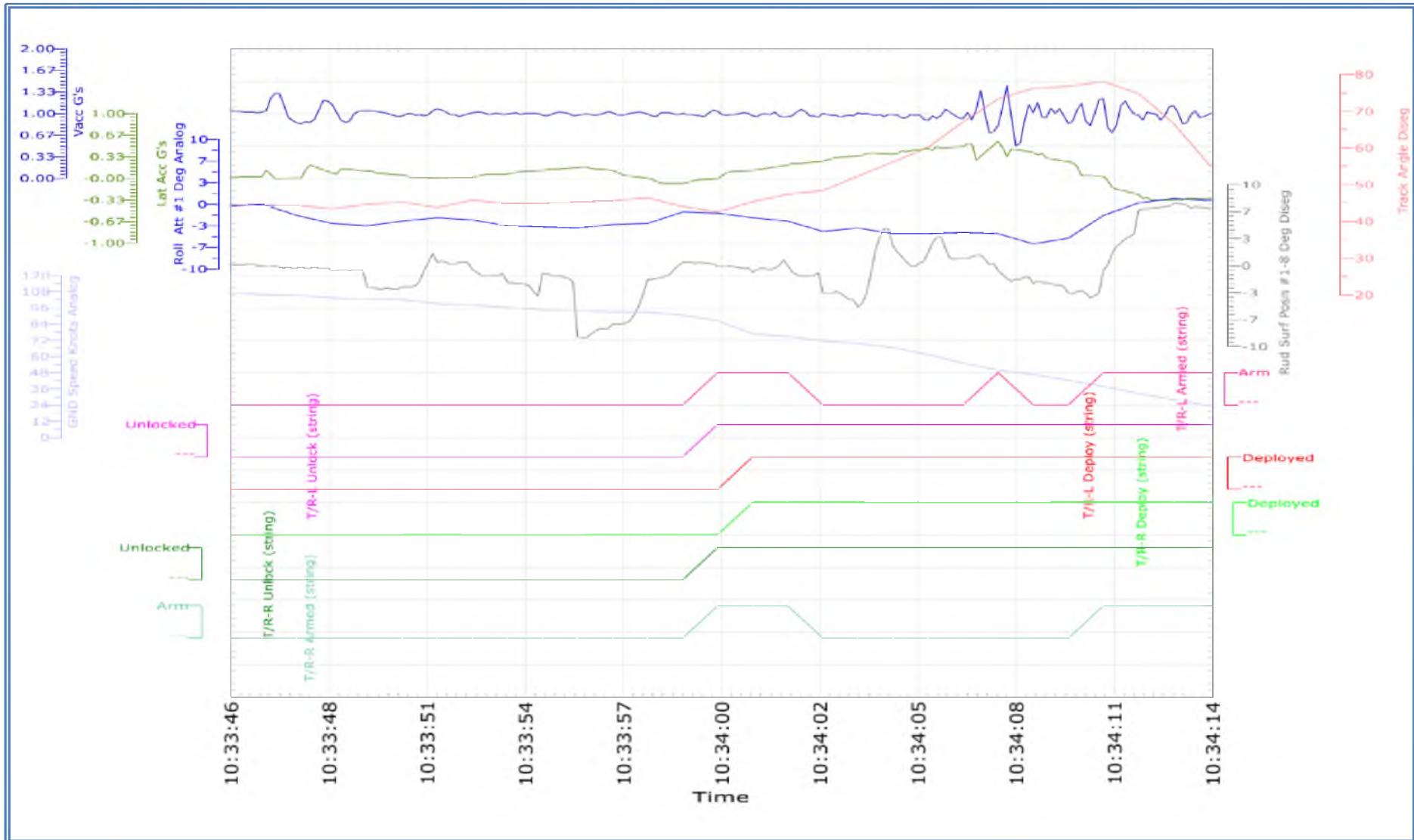
-	Engine 1	Engine 2
N1	29,5 %	29,8 %







10:34:00 Thrust Reverser Left and Right Unlocked

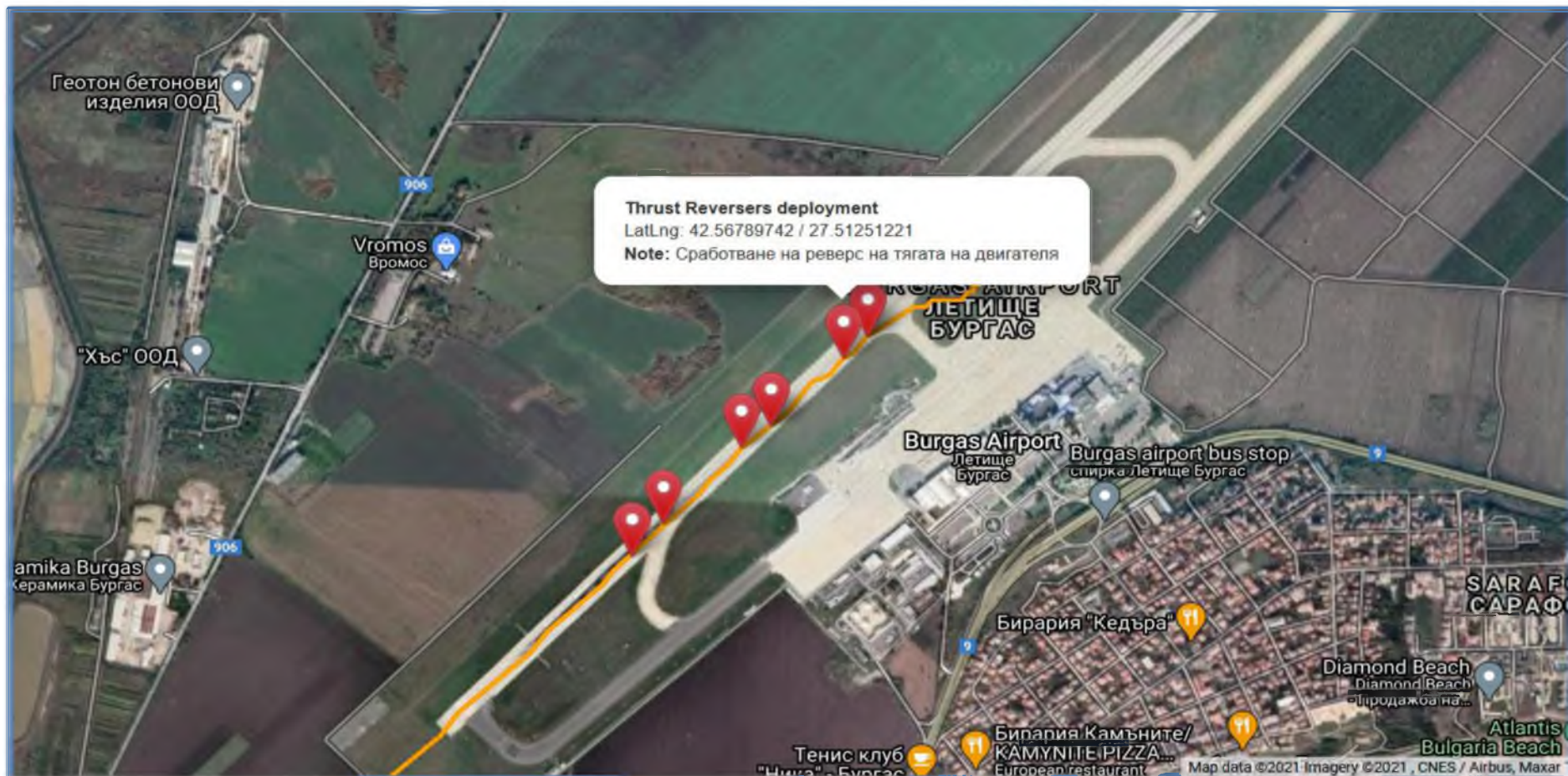


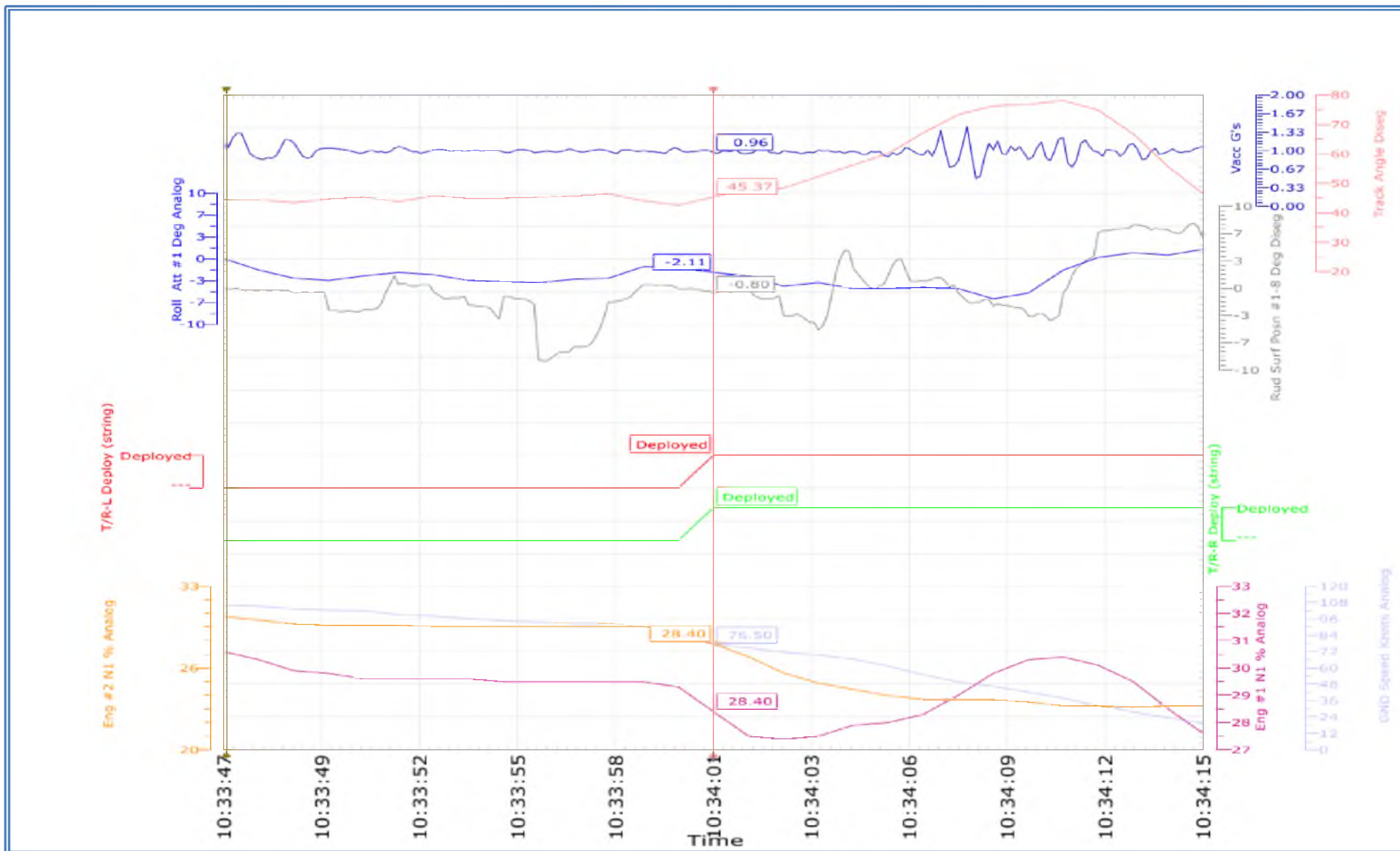


10:34:01 Operation of the reverse thrust of Engine 1 and Engine 2(T/R Deploy) and activation of left and right brakes by Captain and First officer.
GND Speed Knots 76.5

During the reverse thrust, the engines parameters are as follow:

-	Engine 1	Engine 2
N1	28%	28%





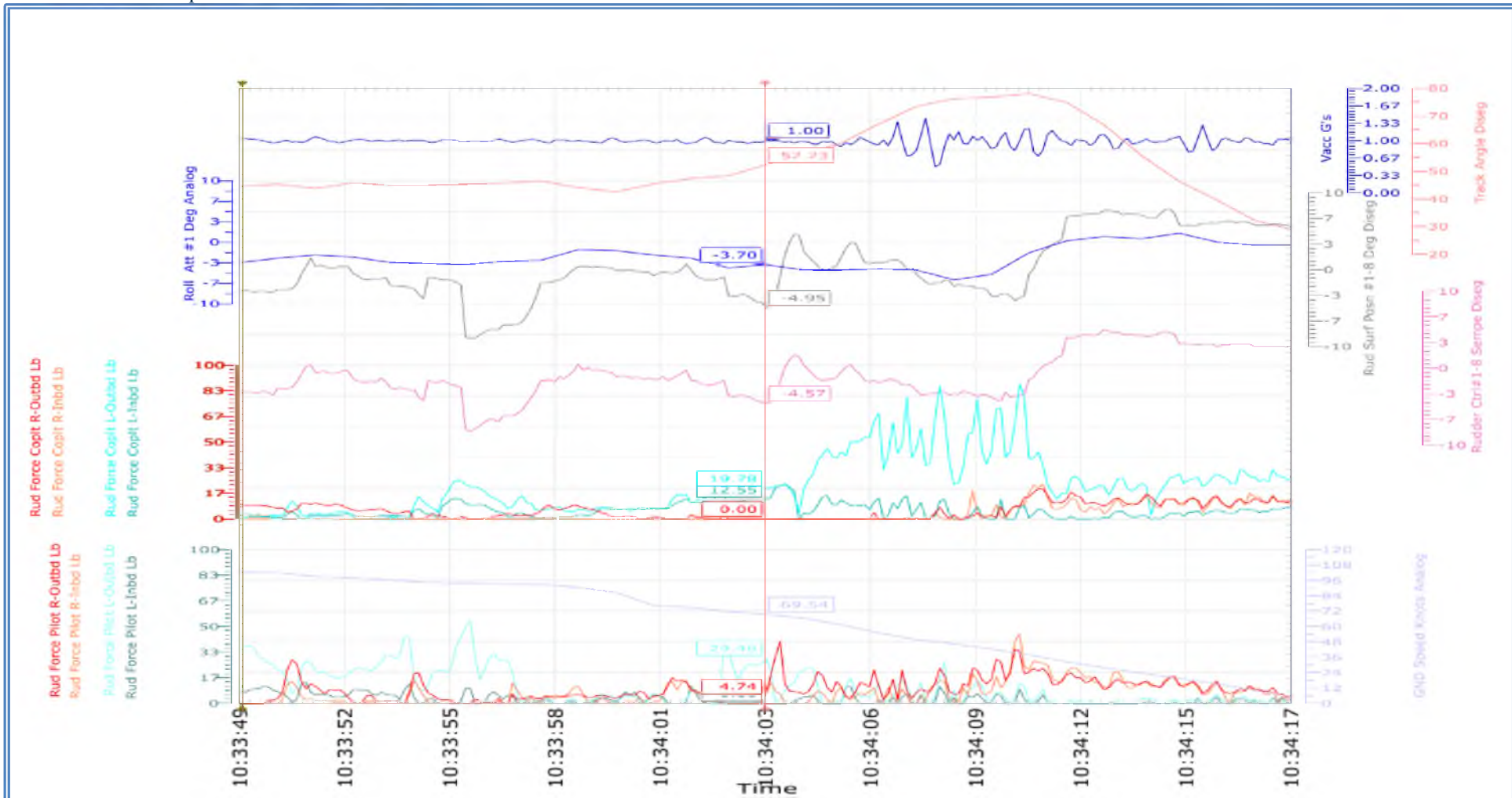


10:34:03 Rudder control command at -4.6 degrees and rudder deflection of -5 degrees

Roll Att #1 Deg -3.7

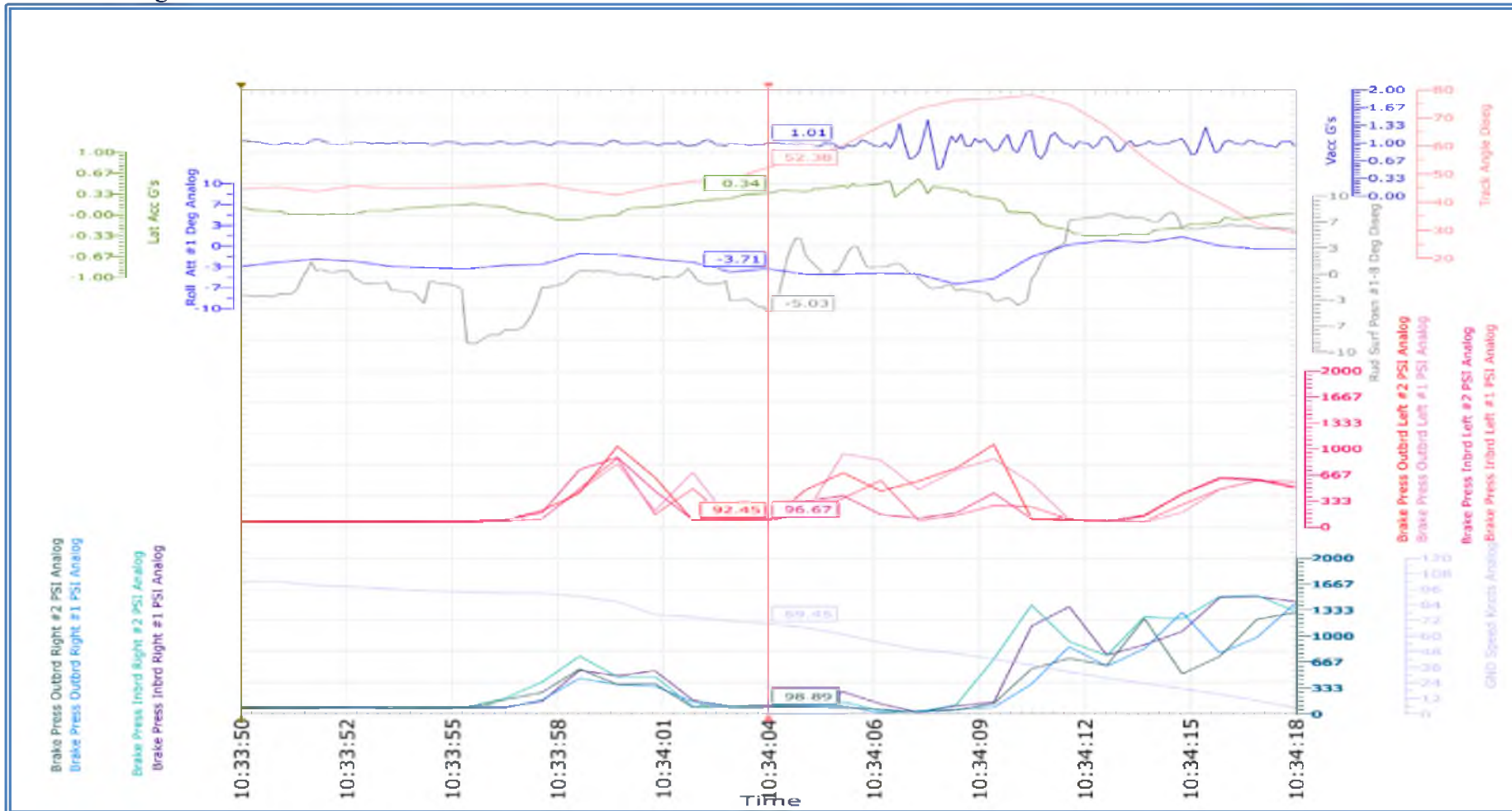
Rud Force Pilot L-Outbd 29.45 Lb

Rud Force Coplt L-Outbd 19.78 Lb





10:34:04 The airplane starts turning right
Rud Surf Posn #1-8 Deg: -5
Roll Att #1 Deg: -3.69
GND Speed Knots: 69.5
Lat Acc: 0.34 g



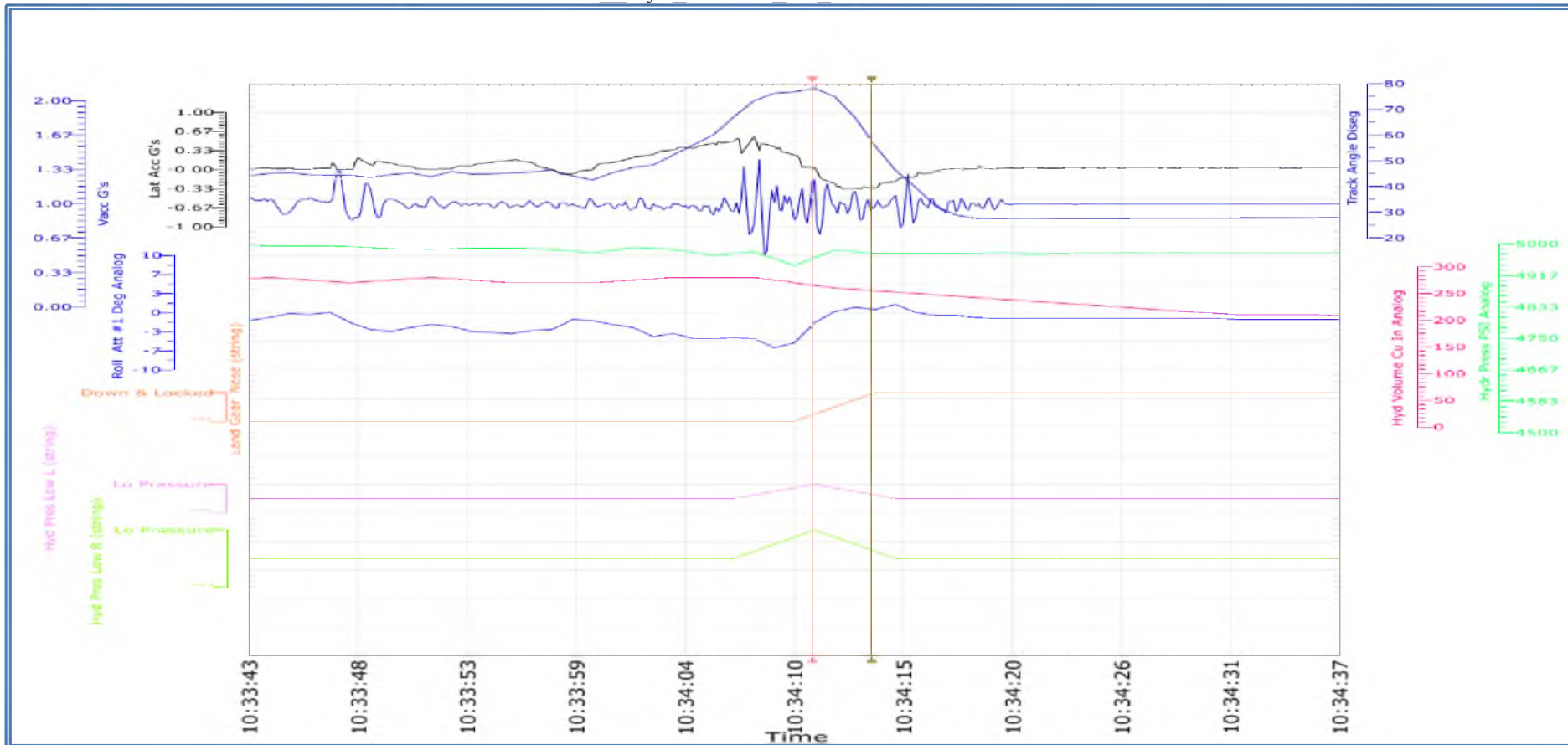


10:34:05 The left brakes on side of the first officer was operated and then was operated left and right brakes on from the Captain and the First officer. Variable pressure of the four brakes. Rudder control command at 0.39 degrees and rudder deflection at 2.39. Indicated air speed 65 kt. and a ground speed 65 kt.

10:34:07 RWY 04 excursion

10:34:10 Rudder control deflection at -3.6 degrees and rudder deflection on -3.2. Indicated air speed is 44 kt and the ground speed is 40 kt. The left and right brakes are triggered by Captain and First officer. Variable pressure of the four brakes.

10:34:11 Signal hydraulic “Low Pressure” for 2 seconds. Parameters A1580_Hyd_Pres_Low_L, A1585_Hyd_Pres_Low_R. Hydraulic Volume decrease from 290 cu/in to 230 cu/in. Parameter A1590_Hyd_Volume_Cu_In.



	Flight Data Recorder Factual Report TC-OYD-20180831	Aero Technic BG Sofia, Bulgaria 1540, Sofia Flight Training Ltd, office No8 E-mail: management@aerotechnic-bg.com https://www.aerotechnic-bg.com/
---	--	--

10:34:13 Rudder control deflection at 5 degrees and rudder deflection on 7.7. Indicated air speed is 30 kt. and a ground speed is 27 kt. The left and right brakes start working by Captain and First Officer. Variable pressure of the four brakes.

10:34:14 Signal for Nose Landing Gear “Down & Locked” change the state to “Not Down & Locked”. Parameter A0825__Land_Gear__Nose

10:34:17 Turn off right-hand engine reverse at 5 kt ground speed. The brakes are triggered by Captain and First officer. Variable pressure of the four brakes.

10:34:18 Turn off left-hand engine reverse at 5 kt ground speed. The brakes are triggered by Captain and First officer. Variable pressure of the four brakes.

10:34:20 The aircraft is completely stopped. The brakes are triggered by Captain and First officer. Maximum brake pressure.

6. Legend

RWY- Runway

TDP- Touchdown Point

GND- Ground

WOW- Weight on Wheel