

NATIONAL TRANSPORTATION SAFETY BOARD
Vehicle Recorder Division
Washington, D.C. 20594

July 20, 2017

Flight Data Recorder

Specialist's Factual Report
By Cassandra Johnson

1. EVENT SUMMARY

Location: Sugar Land, Texas
Date: July 26, 2016
Aircraft: Embraer EMB-505
Registration: N362FX
Operator: Flight Options LLC
NTSB Number: CEN16FA286

On July 26, 2016, at 1509 central daylight time (CDT), an Embraer EMB-505 airplane, N362FX, was substantially damaged during a runway excursion on landing at the Sugar Land Regional Airport (SGR), Sugar Land, Texas. The two pilots sustained minor injuries; the sole passenger was not injured. The airplane was registered to FlexJet LLC and operated by Flight Options LLC under the provisions of Title 14 *Code of Federal Regulations* Part 135 as a corporate/executive flight. Visual meteorological conditions were reported at the airport; however, instrument meteorological conditions prevailed in the local area. The flight was operated on an instrument flight rules flight plan. The flight originated from the Scottsdale Airport (SDL), Scottsdale, Arizona, at 1029 mountain standard time.

2. FLIGHT DATA RECORDER GROUP

A flight data recorder (FDR) group was not convened.

3. FDR Carriage Requirements

The event aircraft, N362FX, was manufactured in 2014, and was operating such that it was not required to be equipped with an FDR.

4. DETAILS OF FDR INVESTIGATION

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following Cockpit Voice and Data Recorder (CVDR):

Recorder Manufacturer/Model: **L-3/Fairchild FA2100-3083**
Recorder Serial Number: **000603248**

4.1. L-3/Fairchild FA2100-3083 Description

The L-3 Cockpit Voice and Data Recorder (CVDR) is a dual function recorder providing both FDR and Cockpit Voice Recorder (CVR) functions. The FDR function records airplane flight information in a digital format using solid-state flash memory as the recording medium. The FA2100-3083 can receive data in the ARINC 573/717/747 configurations and

can record a minimum of 25 hours of flight data. It is configured to record 256 12-bit words of digital information every second. Each grouping of 256 words (each second) is called a subframe. Each subframe has a unique 12-bit synchronization (sync) word identifying it as subframe 1, 2, 3, or 4. The sync word is the first word in each subframe. The data stream is "in sync" when successive sync words appear at proper 256-word intervals. Each data parameter (for example, altitude, heading, airspeed) has a specifically assigned word number within the subframe. The CVDR is designed to meet the crash-survivability requirements of TSO-C123a and TSO-C124a. For the rest of this report, the CVDR will be referred to as an FDR.

4.1.1. Inertia Switch Logic

The FDR is equipped with an inertia switch (also known as a "g-switch" or "negative acceleration sensor"). According to Embraer, the inertia switch is designed to remove power from the FDR when the inertia switch is subjected to load of 5 g or more. For more information regarding the inertia switch, refer to the Cockpit Voice Recorder Group Chairman's Report.

4.1.2. Recorder Condition

The recorder was in good condition and the data were extracted normally from the recorder.

4.1.3. Recording Description

The FDR recording contained approximately 217 hours of data. Timing of the FDR data is measured in subframe reference number (SRN), where each SRN equals one elapsed second. The event flight was the last flight of the recording and its duration was approximately 2 hours and 41 minutes.

4.1.4. Engineering Units Conversions

The engineering units conversions used for the data contained in this report are based on documentation from the aircraft manufacturer. Where applicable, the conversions have been changed to ensure that the parameters conform to the NTSB's standard sign convention that climbing right turns are positive (CRT=+).¹

Table A-1 lists the FDR parameters verified and provided in this report and includes the parameter names, parameter descriptions, and the units. Additionally, table A-2 describes the unit and discrete abbreviations used in this report.

4.1.5. Non-Computed Data Pattern

A non-computed data (NCD) pattern is indicative that the raw data for a given parameter is no longer reliable or not available. The Distance Measurable Equipment Distance-1 (DME Dist-1) parameter had a NCD pattern when its system was not activated.

¹ CRT=+ means that for any parameter recorded that indicates a climb or a right turn, the sign for that value is positive. Also, for any parameter recorded that indicates an action or deflection, if it induces a climb or right turn, the value is positive. Examples: Right Roll = +, Pitch Up = +, Elevator Trailing Edge Up = +, Right Rudder = +.

4.2. Time Correlation

Correlation of the FDR data from SRN to the event local time, CDT, was established by using the recorded Coordinated Universal Time (UTC) time parameters (Time UTC-Hrs, Time UTC-Min, and Time UTC-Sec) and then applying an additional 5 hours offset to change UTC to CDT. Accordingly, the time offset for the event flight data from SRN to local CDT is the following: $CDT = SRN + 92,770$. Therefore, for the rest of this report, all times are referenced as CDT, not SRN.

4.3. FDR Plots and Corresponding Tabular Data

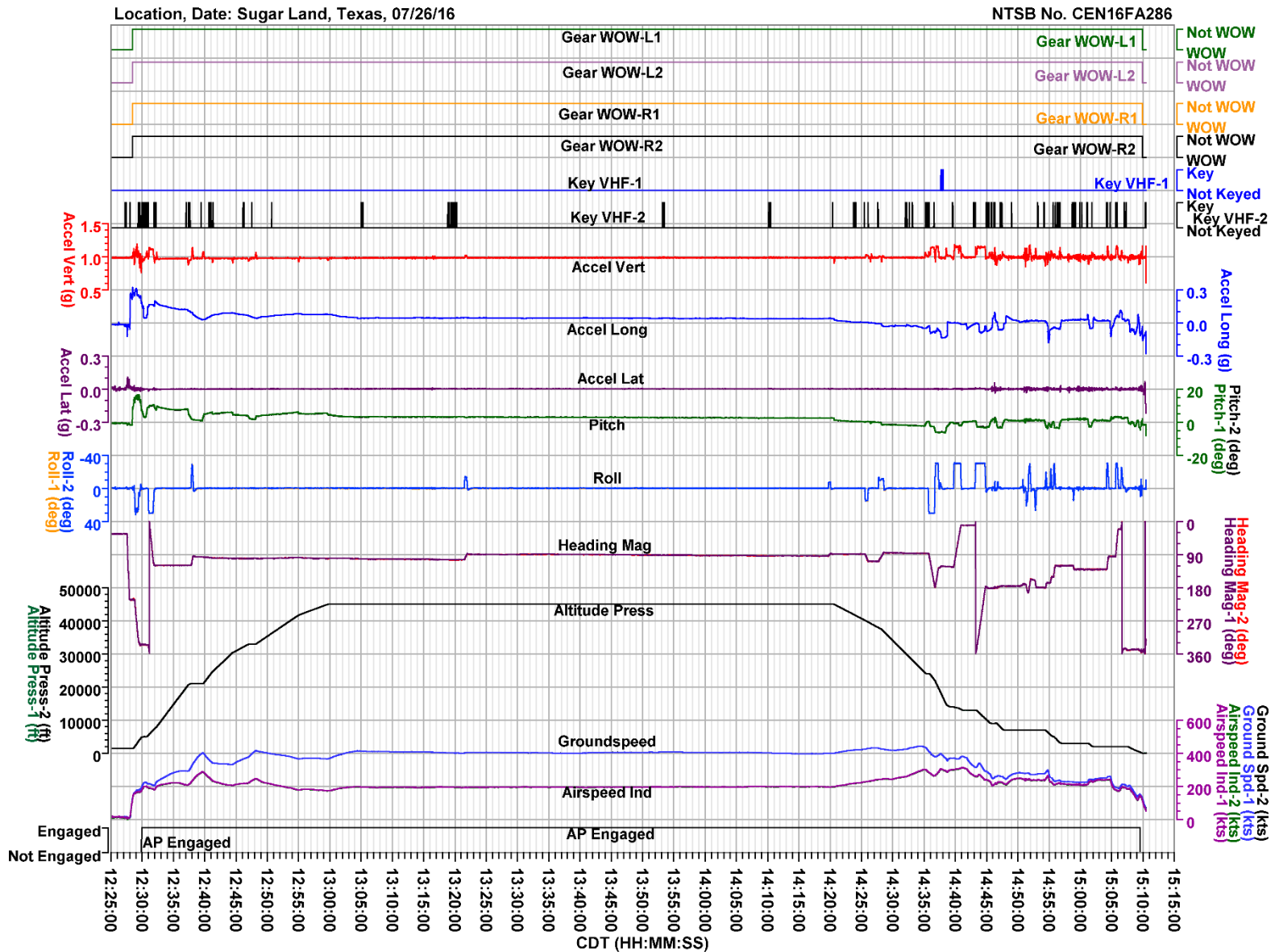
Figures 1 to 8 contain FDR data recorded during the event on July 26, 2016. All the parameters listed in table A-1 are plotted except Time UTC-Hrs, Time UTC-Min, Time UTC-Sec, Latitude-1, Latitude-2, Longitude-1, and Longitude-2. These figures are configured such that right turns are indicated by the trace moving toward the bottom of the page, left turns towards the top of the page, and nose up attitudes towards the top of the page.

Figures 1 to 4 cover the entire event flight from 12:25:00 CDT to the end of the FDR recording at 15:10:31 CDT (the x-axis ends at 15:15:00 CDT). Figures 5 to 8 have expanded scales from 15:09:45 CDT to 15:10:35 CDT covering the final approach from a radio altitude of 91 feet (ft) through landing. Figures 1 and 5 contain basic parameters; figures 2 and 6 contain select parameters; figures 3 and 7 contain select engine parameters; and figures 4 and 8 contain additional select parameters.

The FDR data indicated at about 15:09:55 CDT, approximately 2 hours 41 minutes after takeoff, the left and right main landing gear weight on wheel parameters (Gear WOW-L1, Gear WOW-L2, Gear WOW-R1, and Gear WOW-R2) transitioned from Not Weight on Wheels (Not WOW) to WOW and remained WOW for the rest of the FDR recording. At this time, ground speed (Ground Spd-1 and Ground Spd-2) was about 128 knots (kts). Less than 3 seconds later at 15:09:57.6 CDT, the Anti Skid Fail parameter transitioned from Normal to Fail and remained Fail for the rest of the FDR recording. At this time, the right brake pressure (Brake Press-R) increased from 220 pounds per square inch (psi) to 1000 psi, the ground speed decreased to 123 kts, and the left brake pressure (Brake Press-L) remained at about 80 psi. Less than 2 seconds later at 15:09:59.1 CDT, the right brake pressure increased to 2,950 psi and remained at about 2,950 psi for the rest of the recording. Additionally, ground speed decreased to 119 kts. About 4 seconds later at 15:10:03.1 CDT until 15:10:05.1 CDT, the left brake pressure increased from 70 psi to 2,980 psi and remained at about 2,980 psi for the rest of the recording, except the last data recorded was 240 psi. Also from 15:10:03.1 CDT to 15:10:05.1 CDT, ground speed decreased from 110 kts to 105 kts and the Engine Indication and Crew Alerting System - Anti Skid Fail parameter (EICAS Anti Skid Fail) transitioned from Off to On and remained On for the rest of the recording. About 25 seconds later at 15:10:30.4 CDT, the ground speed reduced to 60 knots and less than 1 second later, at 15:10:31.2 CDT, the data ended. In this accident, the inertia switch removed power from the FDR before the aircraft came to a complete stop.

The tabular data from 12:25:00 CDT to 15:10:31 CDT for all the parameters listed in table A-1 are provided in electronic comma separated value (.csv) format as attachment 1 to this factual report.

Figure 1. Plot of basic parameters during entire flight.

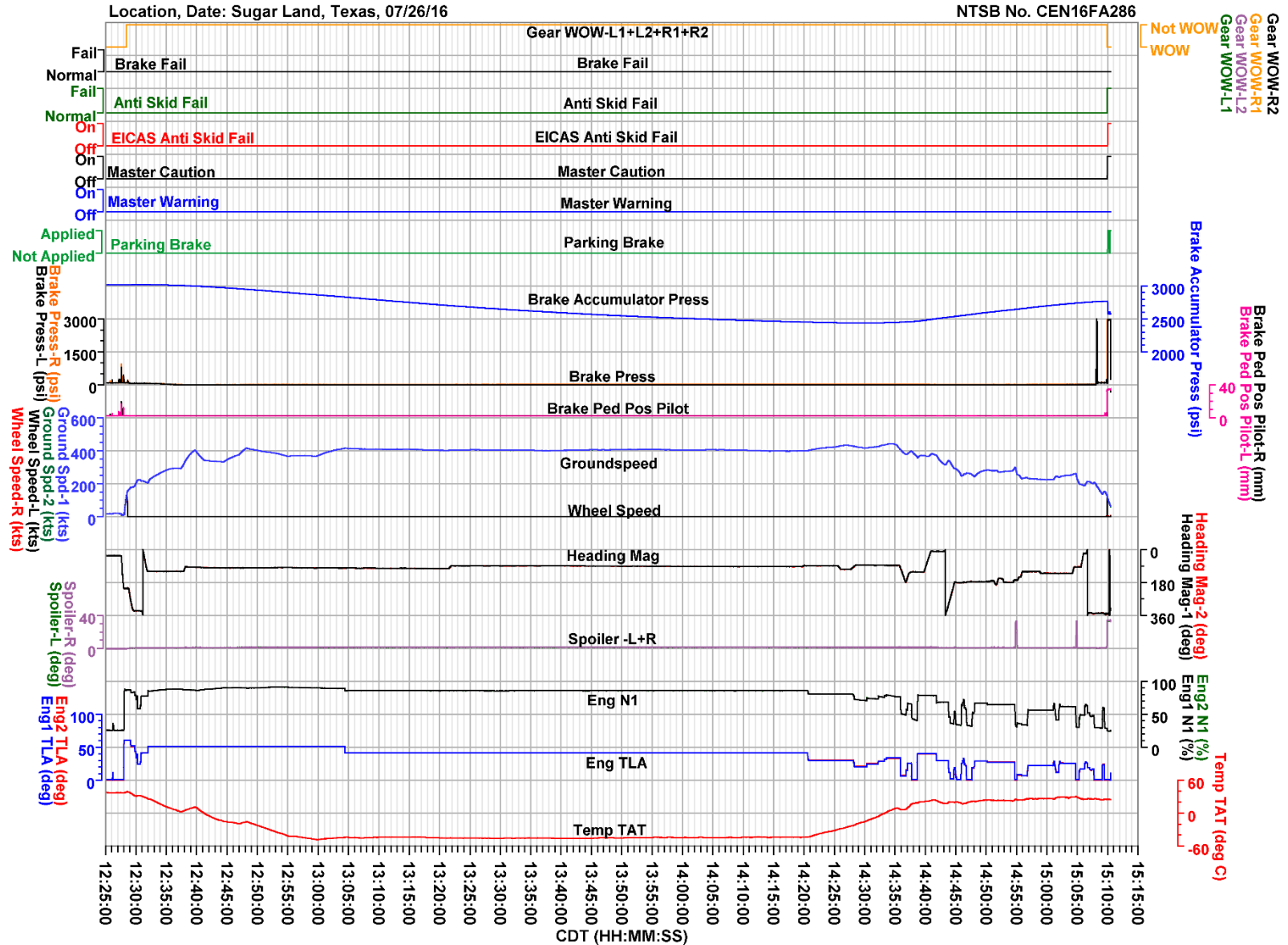


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Figure 2. Plot of select parameters during entire flight.

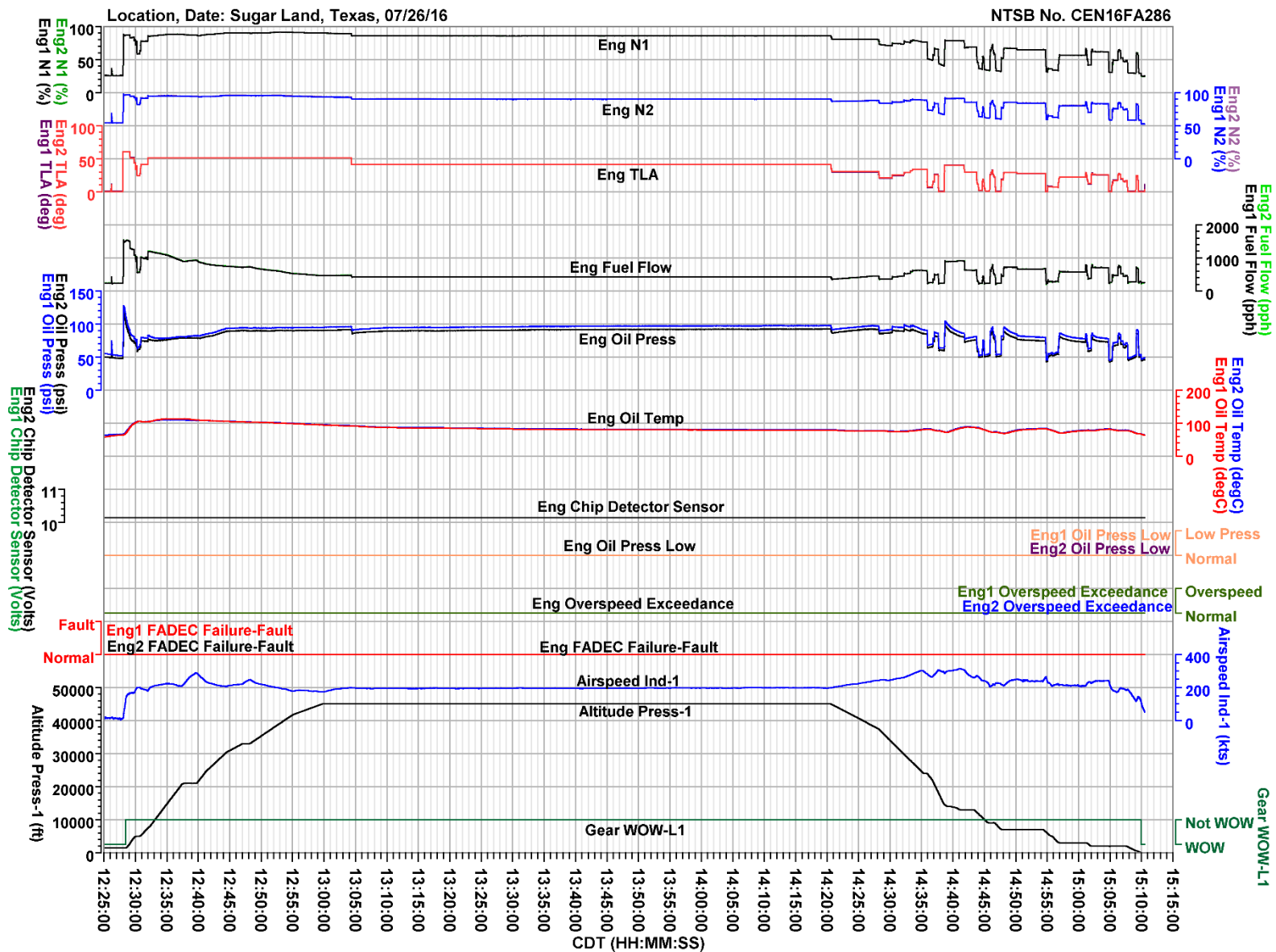


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Figure 3. Plot of select engine parameters during entire flight.



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Figure 4. Plot of additional select parameters during entire flight.

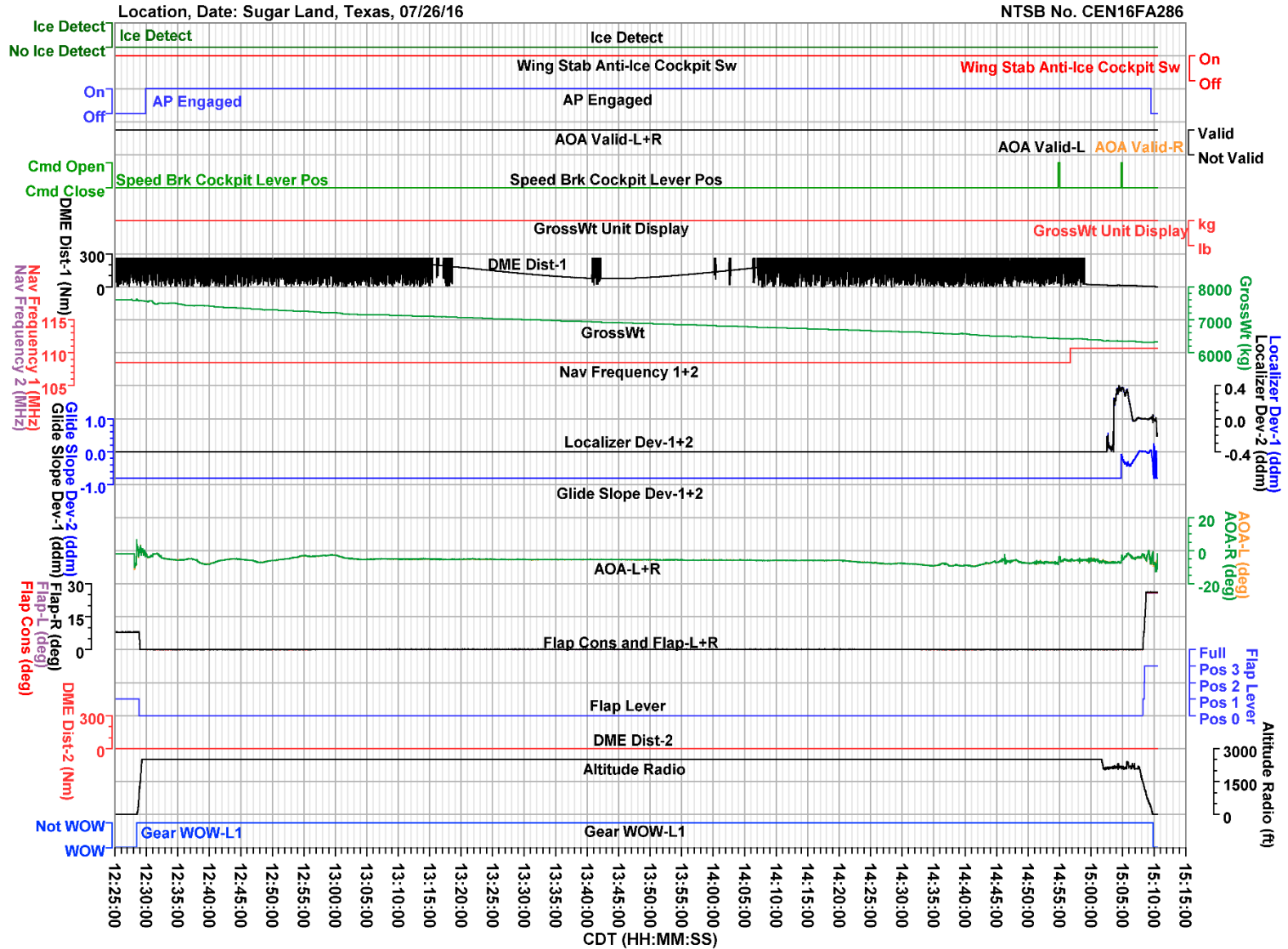
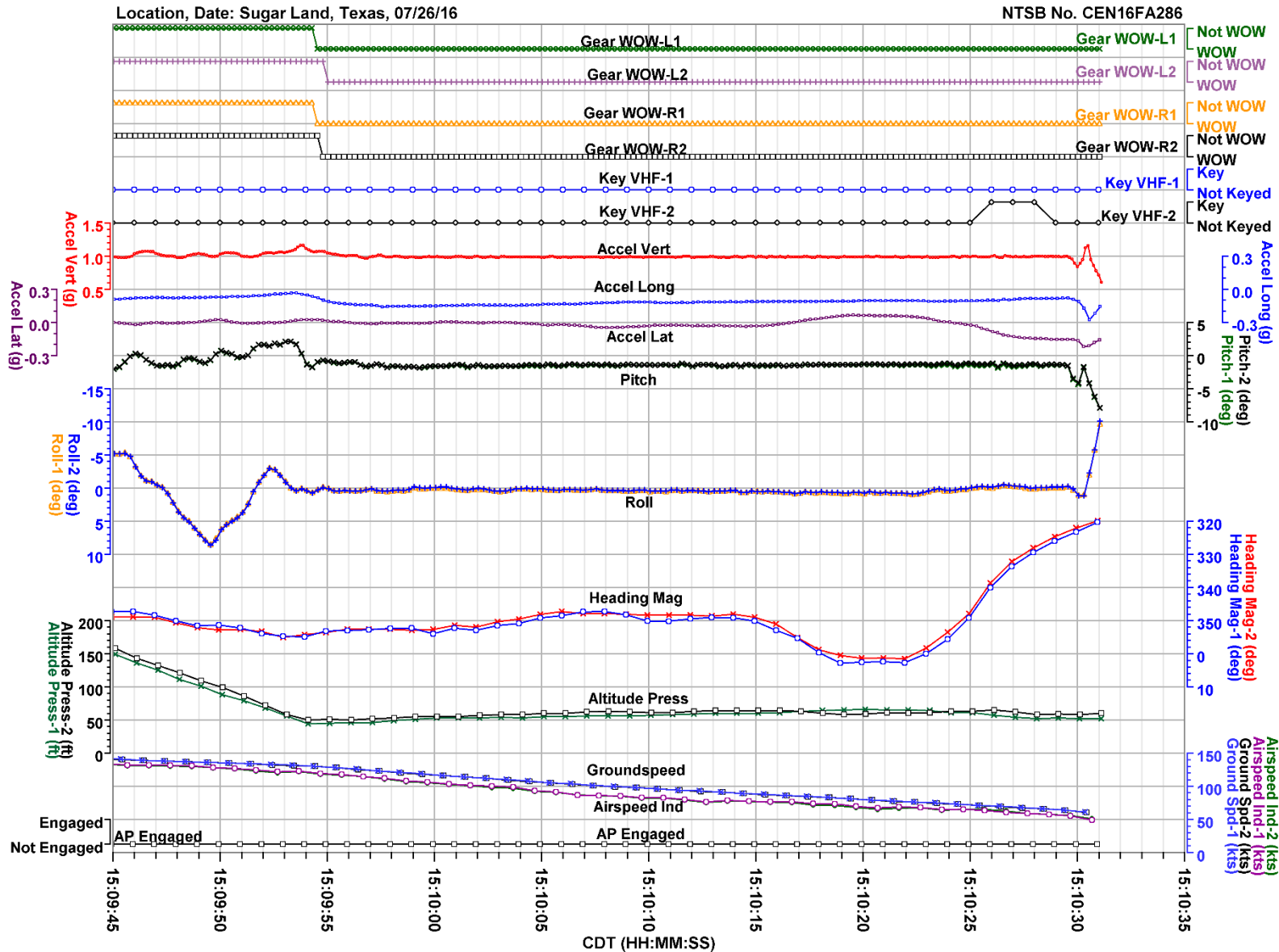


Figure 5. Plot of basic parameters during final descent through the end of the FDR recording.

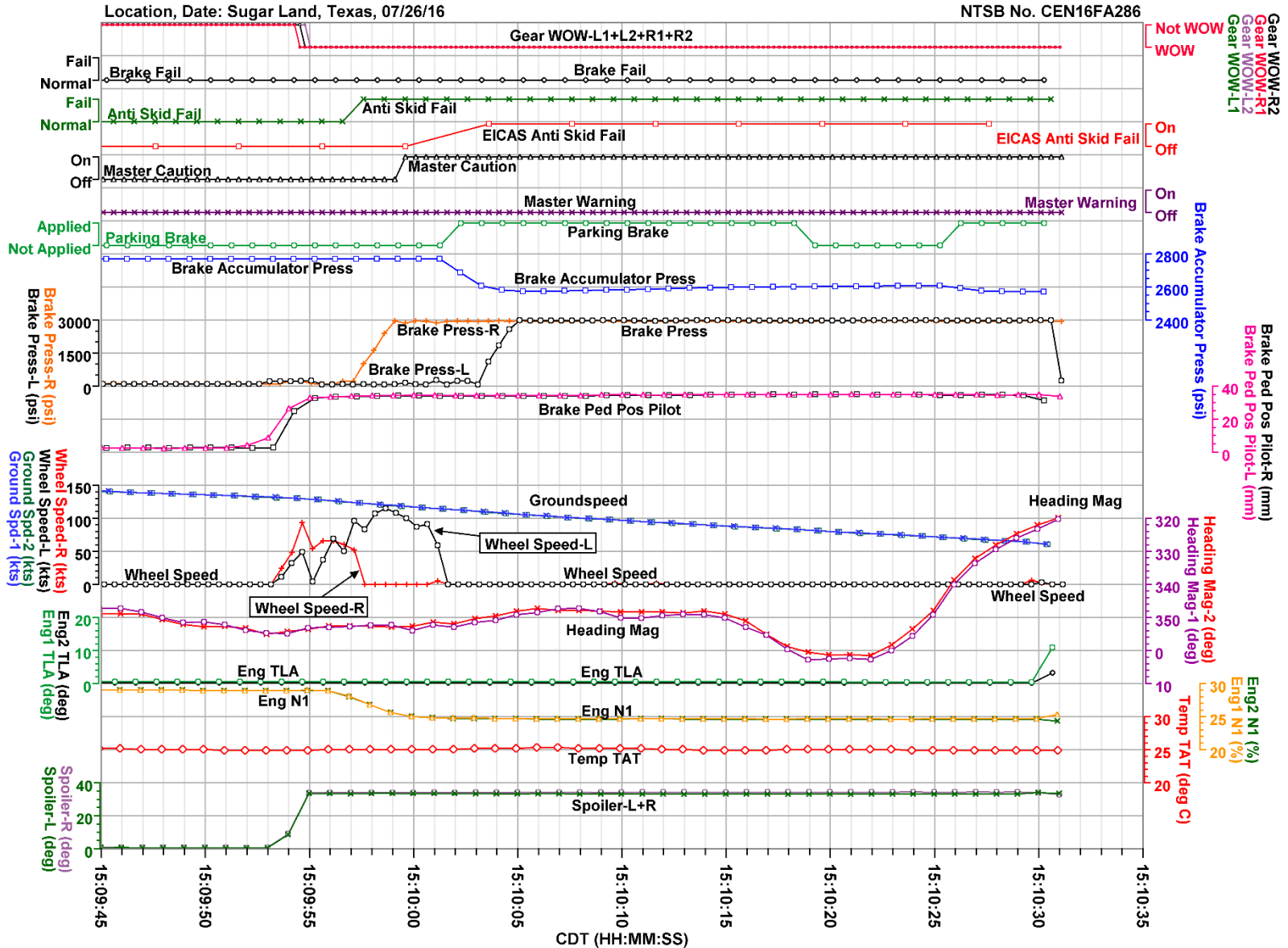


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Figure 6. Plot of select parameters during final descent through the end of the FDR recording.

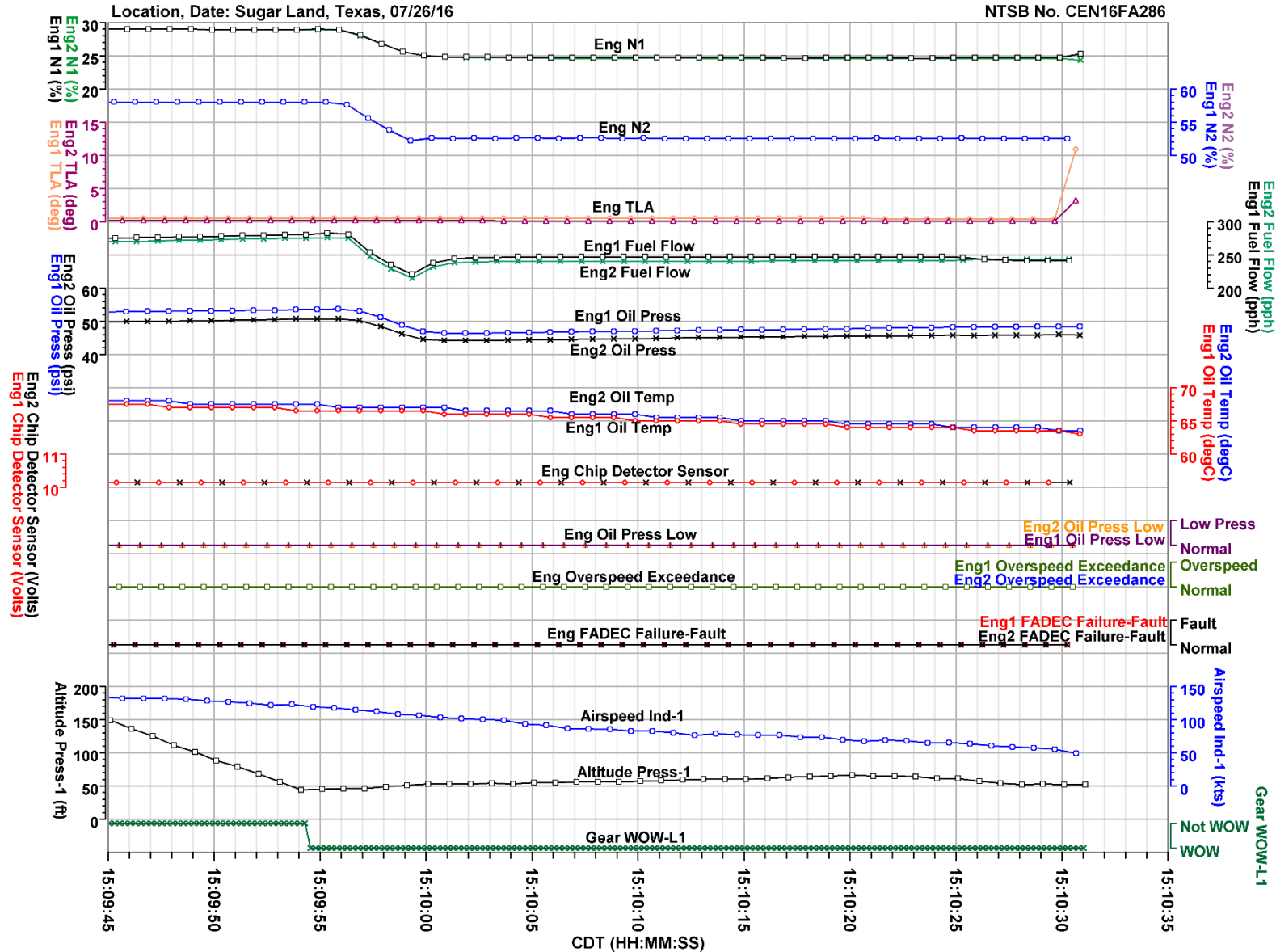


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Figure 7. Plot of select engine parameters during final descent through the end of the FDR recording.

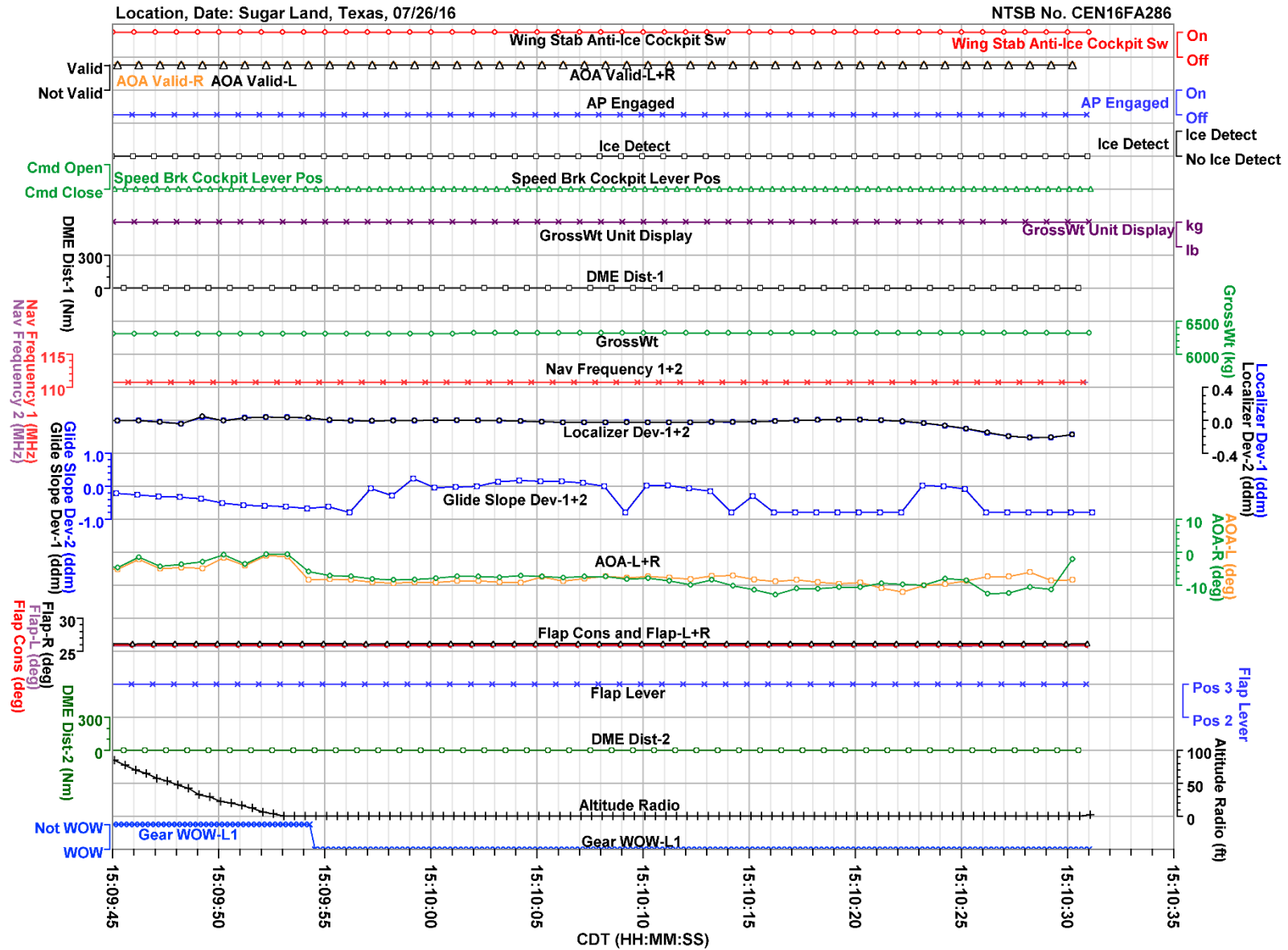


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Figure 8. Plot of additional select parameters during final descent through the end of the FDR recording.



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APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameter names, parameter descriptions, and units. Table A-2 contains the unit and discrete state abbreviations for the parameters.

Table A-1. Verified and provided FDR parameters.

Parameter Names	Parameter Descriptions	Units
1. Accel Lat	Lateral Acceleration	g
2. Accel Long	Longitudinal Acceleration	g
3. Accel Vert	Vertical Acceleration	g
4. Airspeed Ind-1	Indicated Airspeed-1	kts
5. Airspeed Ind-2	Indicated Airspeed-2	kts
6. Altitude Press-1	Pressure Altitude-1	ft
7. Altitude Press-2	Pressure Altitude-2	ft
8. Altitude Radio	Radio Altitude	ft
9. Anti Skid Fail	Anti Skid Fail	
10. AOA Valid-L	Angle of Attack Valid - Left	
11. AOA Valid-R	Angle of Attack Valid - Right	
12. AOA-L	Angle of Attack - Left	deg
13. AOA-R	Angle of Attack - Right	deg
14. AP Engaged	Autopilot Engaged	
15. Brake Accumulator Press	Brake Accumulator Pressure	psi
16. Brake Fail	Brake Fail	
17. Brake Ped Pos Pilot-L	Brake Pedal Position Pilot - Left	mm
18. Brake Ped Pos Pilot-R	Brake Pedal Position Pilot - Right	mm
19. Brake Press-L	Brake Pressure - Left	psi
20. Brake Press-R	Brake Pressure - Right	psi
21. DME Dist-1	Distance Measurable Equipment Distance-1	Nm
22. DME Dist-2	Distance Measurable Equipment Distance-2	Nm
23. EICAS Anti Skid Fail	Engine Indication and Crew Alerting System - Anti Skid Fail	
24. Eng1 Chip Detector Sensor	Engine 1 Chip Detector Sensor	Volts
25. Eng1 FADEC Failure-Fault	Engine 1 Full Authority Digital Engine Controller Failure - Fault	
26. Eng1 Fuel Flow	Engine 1 Fuel Flow	kph
27. Eng1 N1	Engine 1 N1	%
28. Eng1 N2	Engine 1 N2	%

Parameter Names	Parameter Descriptions	Units
29. Eng1 Oil Press	Engine 1 Oil Pressure	psi
30. Eng1 Oil Press Low	Engine 1 Oil Pressure Low	
31. Eng1 Oil Temp	Engine 1 Oil Temperature	degC
32. Eng1 Overspeed Exceedance	Engine 1 Overspeed Exceedance	
33. Eng1 TLA	Engine 1 Thrust Lever Angle	deg
34. Eng2 Chip Detector Sensor	Engine 2 Chip Detector Sensor	Volts
35. Eng2 FADEC Failure-Fault	Engine 2 Full Authority Digital Engine Controller Failure - Fault	
36. Eng2 Fuel Flow	Engine 2 Fuel Flow	kph
37. Eng2 N1	Engine 2 N1	%
38. Eng2 N2	Engine 2 N2	%
39. Eng2 Oil Press	Engine 2 Oil Pressure	psi
40. Eng2 Oil Press Low	Engine 2 Oil Pressure Low	
41. Eng2 Oil Temp	Engine 2 Oil Temperature	degC
42. Eng2 Overspeed Exceedance	Engine 2 Overspeed Exceedance	
43. Eng2 TLA	Engine 2 Thrust Lever Angle	deg
44. Flap Cons	Flap Consolidated Surface Position	deg
45. Flap Lever	Flap Lever Position	
46. Flap-L	Flap Position - Left	deg
47. Flap-R	Flap Position - Right	deg
48. Gear WOW-L1	Weight on Wheels Left Main Landing Gear Sensor 1	
49. Gear WOW-L2	Weight on Wheels Left Main Landing Gear Sensor 2	
50. Gear WOW-R1	Weight on Wheels Right Main Landing Gear Sensor 1	
51. Gear WOW-R2	Weight on Wheels Right Main Landing Gear Sensor 2	
52. Glide Slope Dev-1	Glideslope Deviation - 1	ddm
53. Glide Slope Dev-2	Glideslope Deviation - 2	ddm
54. GrossWt	Gross Weight	kg
55. GrossWt Unit Display	Gross Weight Unit Crew Display	
56. Ground Spd-1	Ground Speed - 1	kts
57. Ground Spd-2	Ground Speed - 2	kts
58. Heading Mag-1	Magnetic Heading - 1	deg
59. Heading Mag-2	Magnetic Heading - 2	deg
60. Ice Detect	Ice Detected	
61. Key VHF-1	Microphone Keying-1	
62. Key VHF-2	Microphone Keying-2	

Parameter Names	Parameter Descriptions	Units
63. Latitude-1	Latitude Position - 1	deg
64. Latitude-2	Latitude Position - 2	deg
65. Localizer Dev-1	Localizer Deviation - 1	ddm
66. Localizer Dev-2	Localizer Deviation - 2	ddm
67. Longitude-1	Longitude Position - 1	deg
68. Longitude-2	Longitude Position - 2	deg
69. Master Caution	Master Caution	
70. Master Warning	Master Warning	
71. Nav Frequency 1	Navigation Frequency 1	MHz
72. Nav Frequency 2	Navigation Frequency 2	MHz
73. Parking Brake	Parking Brake	
74. Pitch-1	Pitch Angle - 1	deg
75. Pitch-2	Pitch Angle - 2	deg
76. Roll-1	Roll Angle - 1	deg
77. Roll-2	Roll Angle - 2	deg
78. Speed Brk Cockpit Lever Pos	Speed Brake Cockpit Lever Position	
79. Spoiler-L	Spoiler Position - Left	deg
80. Spoiler-R	Spoiler Position - Right	deg
81. Temp TAT	Total Air Temperature	deg C
82. Time UTC-Hr	Coordinated Universal Time - Hours	Hrs
83. Time UTC-Min	Coordinated Universal Time - Min	min
84. Time UTC-Sec	Coordinated Universal Time - Sec	sec
85. Wheel Speed-L	Wheel Speed - Left	kts
86. Wheel Speed-R	Wheel Speed - Right	kts
87. Wing Stab Anti-Ice Cockpit Sw	Wing Stabilizer Anti-Ice Cockpit Switch	

NOTE: This FDR records pressure altitude, which is based on a standard altimeter setting of 29.92 inches of mercury (in Hg). The pressure altitude information presented in the FDR plots and in the electronic data has not been corrected for the local altimeter setting at the time of the event.

NOTE: Parameters with a blank unit description in table A-1 are discretes. A discrete is typically a 1-bit parameter that is either a 0 state or a 1 state where each state is uniquely defined for each parameter.

Table A-2. Unit and discrete abbreviations.

Unit and discrete Abbreviations	Descriptions
%	percentage
Cmd	Command
ddm	difference in depth of modulation
deg	degrees

Unit and discrete Abbreviations	Descriptions
degC	degrees Celsius
Detect	Detected
ft	feet
hrs	hours
kg	kilograms
kph	kilograms per hour
kts	knots
lb	pounds
MHz	Megahertz
min	minutes
mm	millimeters
Nm	Nautical Miles
Pos 0	Position 0
Pos 1	Position 1
Pos 2	Position 2
Pos 3	Position 3
Press	Pressure
psi	pounds per square inch
sec	seconds
Volts	Volts
WOW	weight on wheels