

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

December 19, 2019

## **Flight Data Recorder**

**Specialist's Factual Report**  
**By Cassandra Johnson**

### **1. EVENT SUMMARY**

Location: Seattle, Washington  
Date: November 7, 2017  
Aircraft: Airbus 330-243  
Registration: N375HA  
Operator: Hawaiian Airlines  
NTSB Number: ENG18IA003

On November 7, 2017, a Hawaiian Airlines Airbus 330-243, registration N375HA, sustained an un-commanded rollback of the left-hand engine during cruise and performed an emergency landing at Seattle-Tacoma International Airport (KSEA), Seattle, Washington. After touchdown, the engine emitted sufficient liquid fuel and flames from the exhaust to cause thermal damage to the nacelle, pylon, wing and flaps. The engine was a Rolls Royce Trent 700.

The airplane had just left Paine Field Airport (KPAE), Everett, Washington and was on a ferry flight to KSEA after having interior upgrades installed. There were no passengers on board.

### **2. FLIGHT DATA RECORDER GROUP**

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

### **3. FDR CARRIAGE REQUIREMENTS**

The event aircraft, N375HA, was manufactured in 2015, and was operating such that it was required to be equipped with an FDR that recorded, at a minimum, 88 parameters, as cited in Title 14 *Code of Federal Regulations* Part 121.344(f).

### **4. DETAILS OF FDR INVESTIGATION**

The National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following FDR:

Recorder Manufacturer/Model: **L-3/Fairchild FA2100**  
Recorder Serial Number: **000844659**

#### **4.1. L-3/Fairchild FA2100 Description**

This model FDR records airplane flight information in a digital format using solid-state flash memory as the recording medium. The FA2100 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 1024 12-bit words of digital information every second. Each grouping of 1024 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 1024-word intervals. Each data parameter (e.g. altitude, heading, airspeed) has a specifically assigned word number within the subframe. The FA2100 is designed to meet the crash-survivability requirements of TSO-C124a.

#### **4.1.1. Recorder Condition**

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

#### **4.1.2. Recording Description**

The FDR recording contained approximately 114 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 10 minutes. The parameters evaluated for the purpose of this report appeared to be in accordance with federal FDR carriage requirements.

#### **4.1.3. Engineering Units Conversions**

The engineering unit 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=+).<sup>1</sup>

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

#### **4.1.4. Non-Computed Data Pattern**

When the aircraft is on the ground, a non-computed data (NCD) pattern was recorded in 26 parameters. These parameters are designated with a note in table A-1. An NCD pattern is indicative that the raw data was no longer reliable or not available.

### **4.2. Time Correlation**

Correlation of the FDR data from SRN to the event local time, Pacific standard time (PST), was established by using the recorded Coordinated Universal Time (UTC) Hours (Hrs), UTC Minutes (Min), and UTC Seconds (Sec) and then applying an additional 8 hours offset to change UTC to PST.

Accordingly, the time offset for the event flight data from SRN to local PST is the following:  $PST = SRN - 332,698$ . Therefore, for the rest of this report, all times are referenced as PST, not SRN. However, previous flights are referenced as SRN, not local time.

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<sup>1</sup> 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 = +.

### 4.3. FDR Plots and Corresponding Tabular Data

Figures 1 to 9 contain FDR data recorded during the event on November 7, 2017. Figures 10 and 11 contain FDR data recorded during the first previous flight and the second previous flight, respectively. All the FDR parameters listed in table A-1 are plotted except Time UTC Hrs, Time UTC Min, and Time UTC Sec.

The following three set of figures contain all the FDR parameters listed in table A-1 except Time UTC Hrs, Time UTC Min, and Time UTC Sec: figures 1 and 2, figures 3 and 4, and figures 5 and 6.

Additionally, the following five figures contain all the FDR parameters listed in table A-1 except Time UTC Hrs, Time UTC Min, and Time UTC Sec: figure 7, figure 8, figure 9, figure 10, and figure 11.

Figures 1 and 2 contain 22 minutes of data from 20:42:00 PST to 21:04:00 PST. The data starts about 10 minutes before takeoff and ends about 2 minutes and 11 seconds after touchdown.

Figures 3 and 4 contain 2 minutes of data from 21:01:35 PST to 21:03:35 PST. The data starts about 14 seconds prior to touchdown and ends 1 minute and 46 seconds after touchdown.

Figures 5 and 6 contain 4 minutes and 40 seconds of data from 20:58:20 PST to 21:03:00 PST. The data starts during the final approach at a pressure altitude of 2,652 feet (ft) and ends 1 minute and 11 seconds after touchdown.

Figure 7 starts during the final approach at a pressure altitude of 2,940 ft at 20:58:00 PST and ends at a pressure altitude of 692 ft at 21:01:10 PST. Figure 8 starts at 21:01:10 PST and ends at 21:03:40 PST (1 minute and 51 seconds after touchdown). Figure 9 encompasses the entire time covered in figures 7 and 8 (from 20:58:00 PST to 21:03:40 PST).

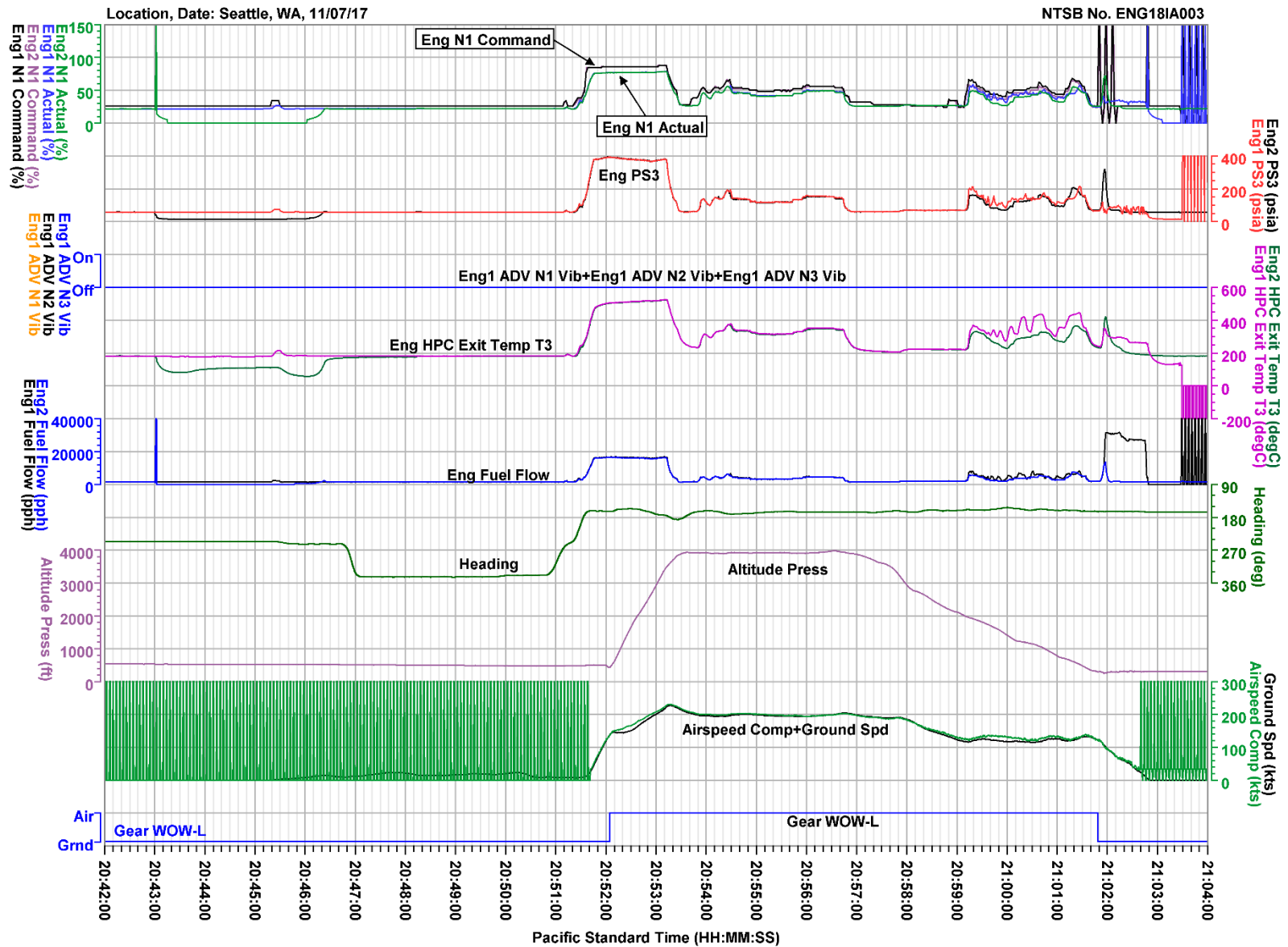
Figure 10 covers the entire first previous flight from 398,700 SRN to 399,420 SRN. Lastly, Figure 11 covers the entire second previous flight from 374,000 SRN to 395,600 SRN.

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.

In brief, the FDR data indicated, while descending through a pressure altitude of 1,952 ft, there were engine variations starting at about 20:59:14 PST and continued through touchdown at 21:01:49 PST until engine 1 was shut down at about 21:03:06 PST.

The corresponding tabular data used to create figures 1 to 9, including Time UTC Hrs, Time UTC Min, and Time UTC Sec, are provided in electronic comma separated value (\*.csv) format as attachment 1 to this report. Additionally, the corresponding tabular data used to create figure 10 and 11, including Time UTC Hrs, Time UTC Min, and Time UTC Sec, are provided in electronic comma separated value (\*.csv) format as attachments 2 and 3, respectively, to this report.

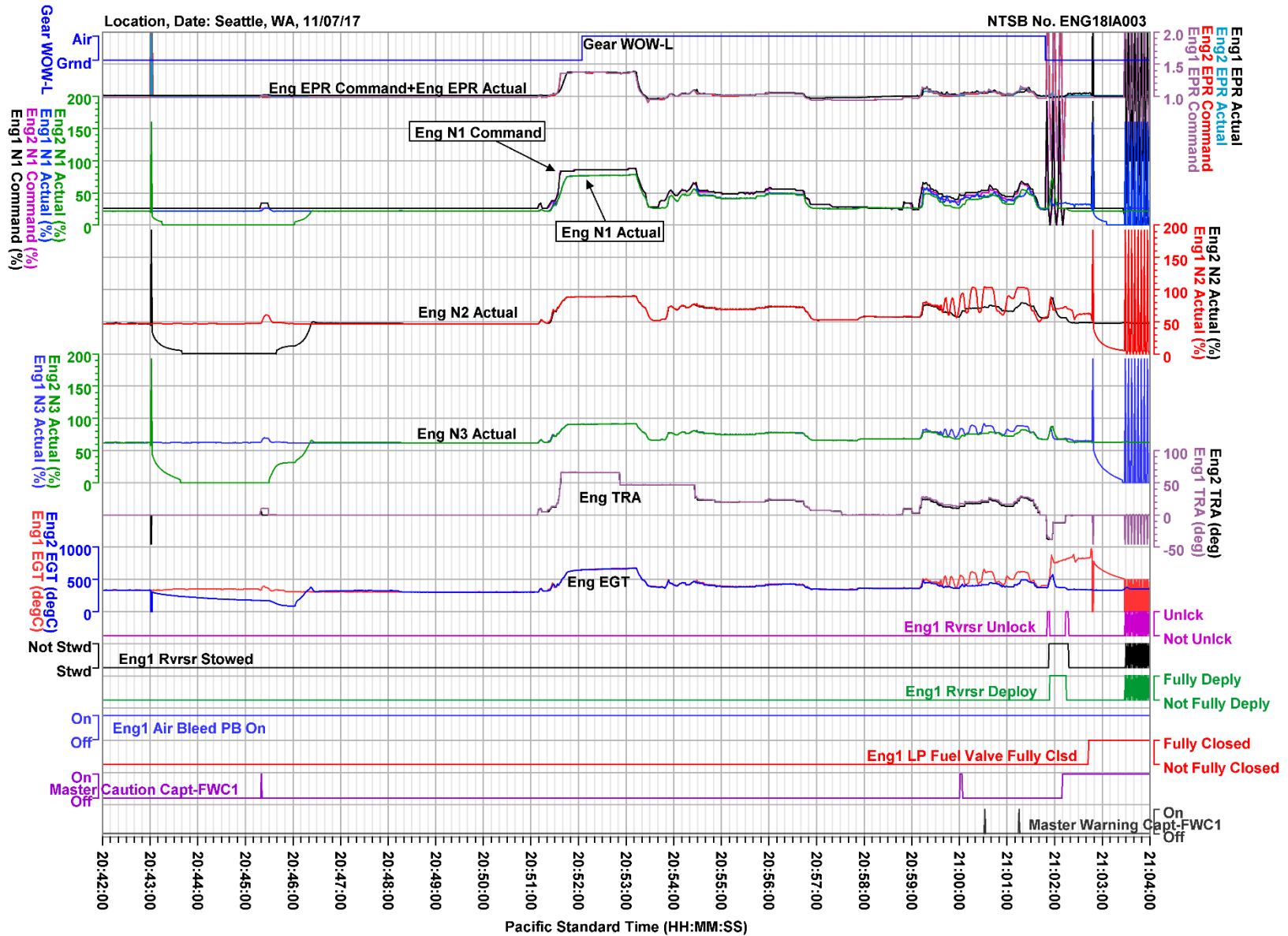
Figure 1. Plot of FDR parameters from 20:42:00 PST to 21:04:00 PST (22 minutes).



Data starts 10 min 4 sec before takeoff and ends 2 min 11 sec after touchdown (22 min total)

National Transportation Safety Board

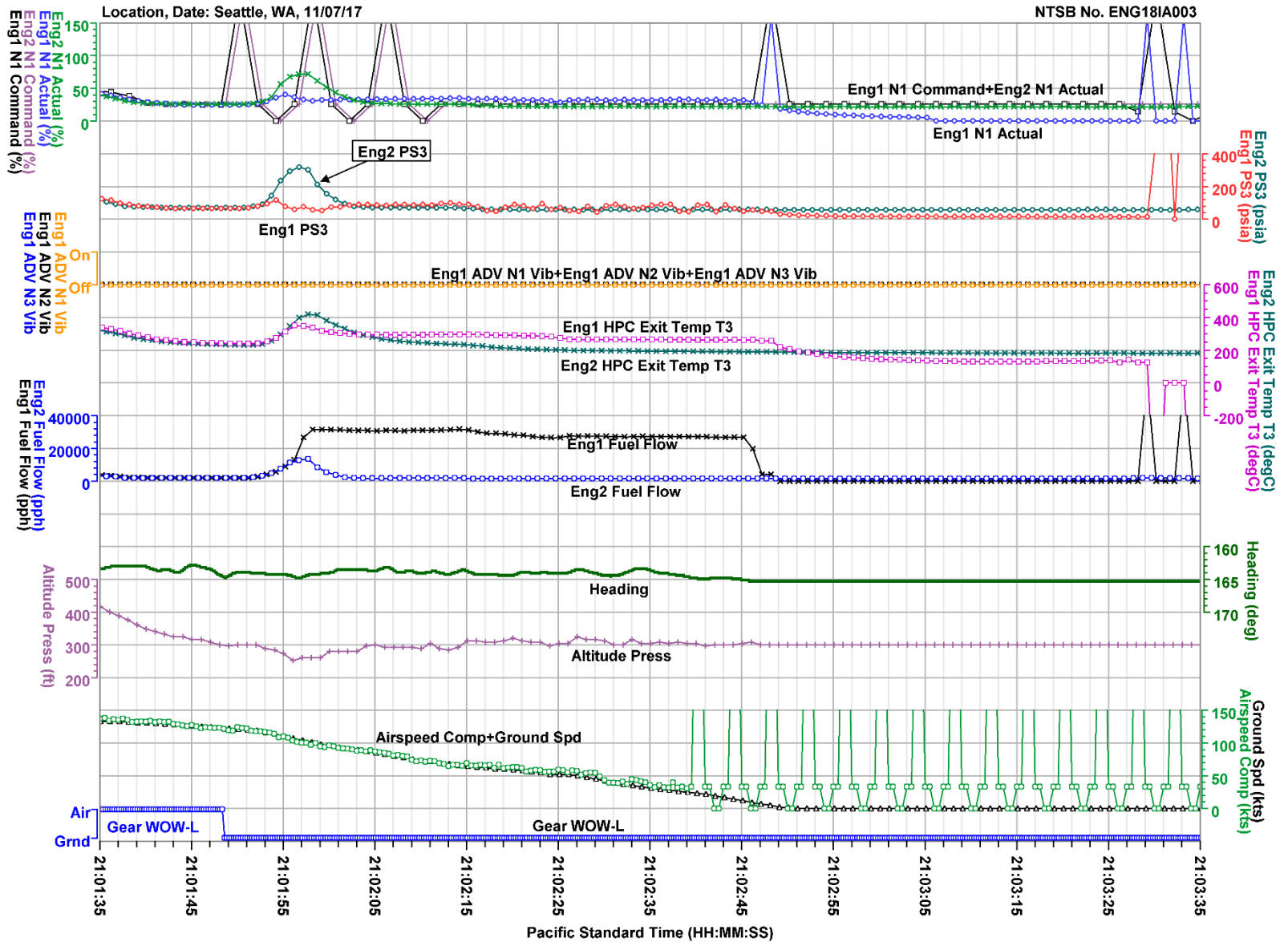
Figure 2. Plot of additional FDR parameters from 20:42:00 PST to 21:04:00 PST (22 minutes).



Data starts 10 min 4 sec before takeoff and ends 2 min 11 sec after touchdown (22 min total)

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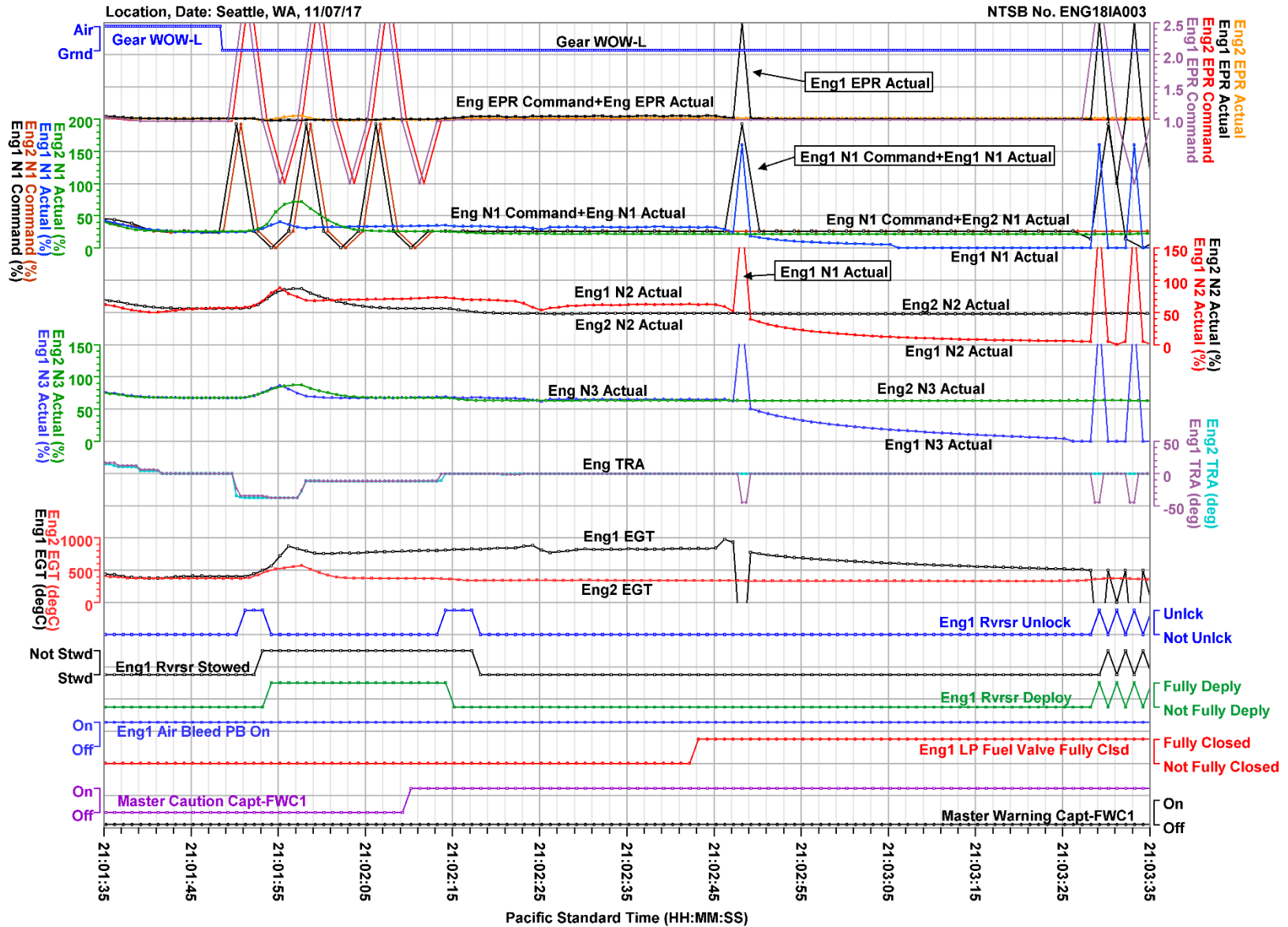
Figure 3. Plot of FDR parameters from 21:01:35 PST to 21:03:35 PST (2 minutes).



Data starts 14 sec prior to touchdown and ends 1 min 46 sec after touchdown (2 min total)

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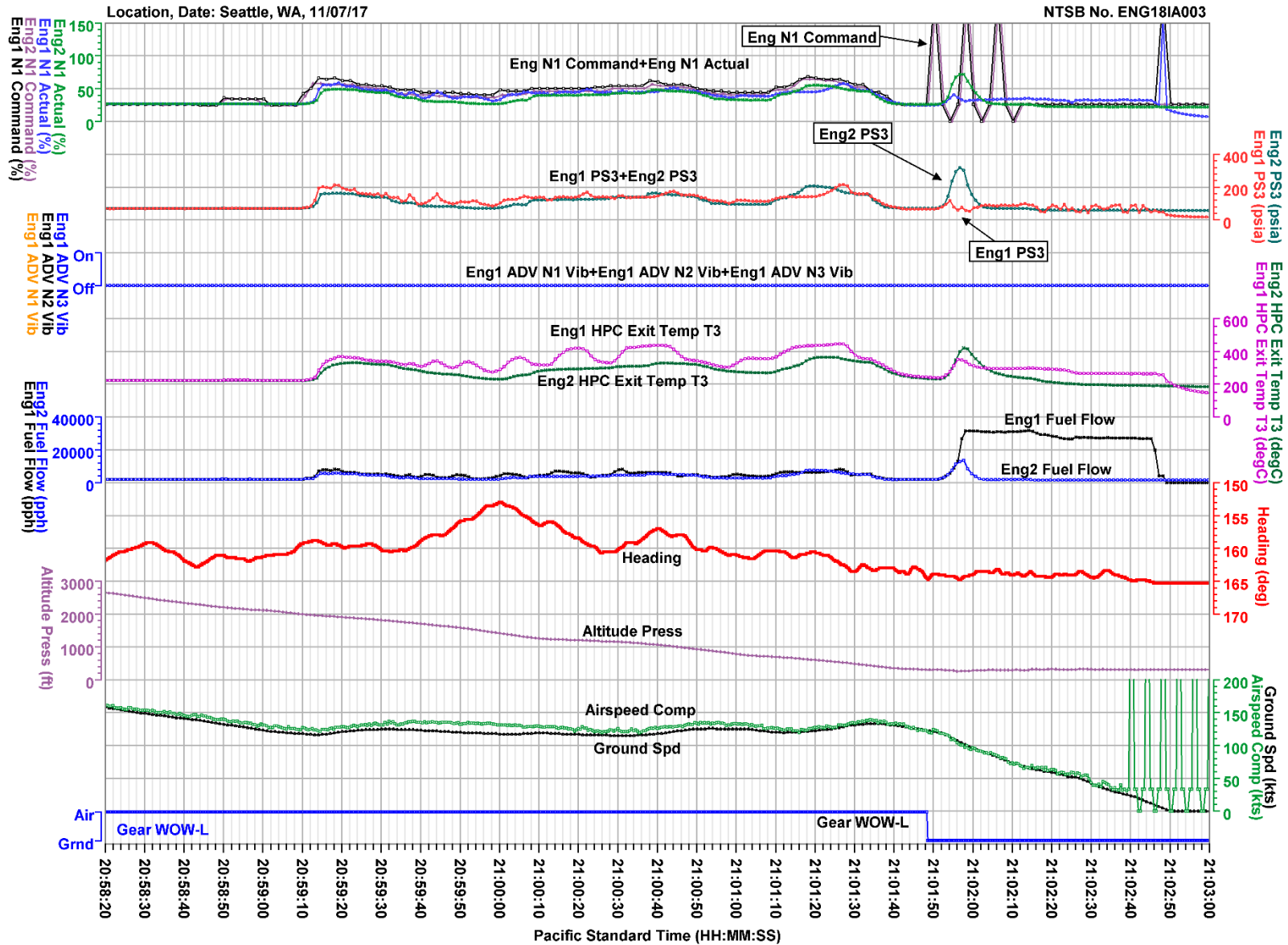
Figure 4. Plot of additional FDR parameters from 21:01:35 PST to 21:03:35 PST (2 minutes).



Data starts 14 sec prior to touchdown and ends 1 min 46 sec after touchdown (2 min total)

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Figure 5. Plot of FDR parameters from 20:58:20 PST to 21:03:00 PST (4 minutes 40 seconds).

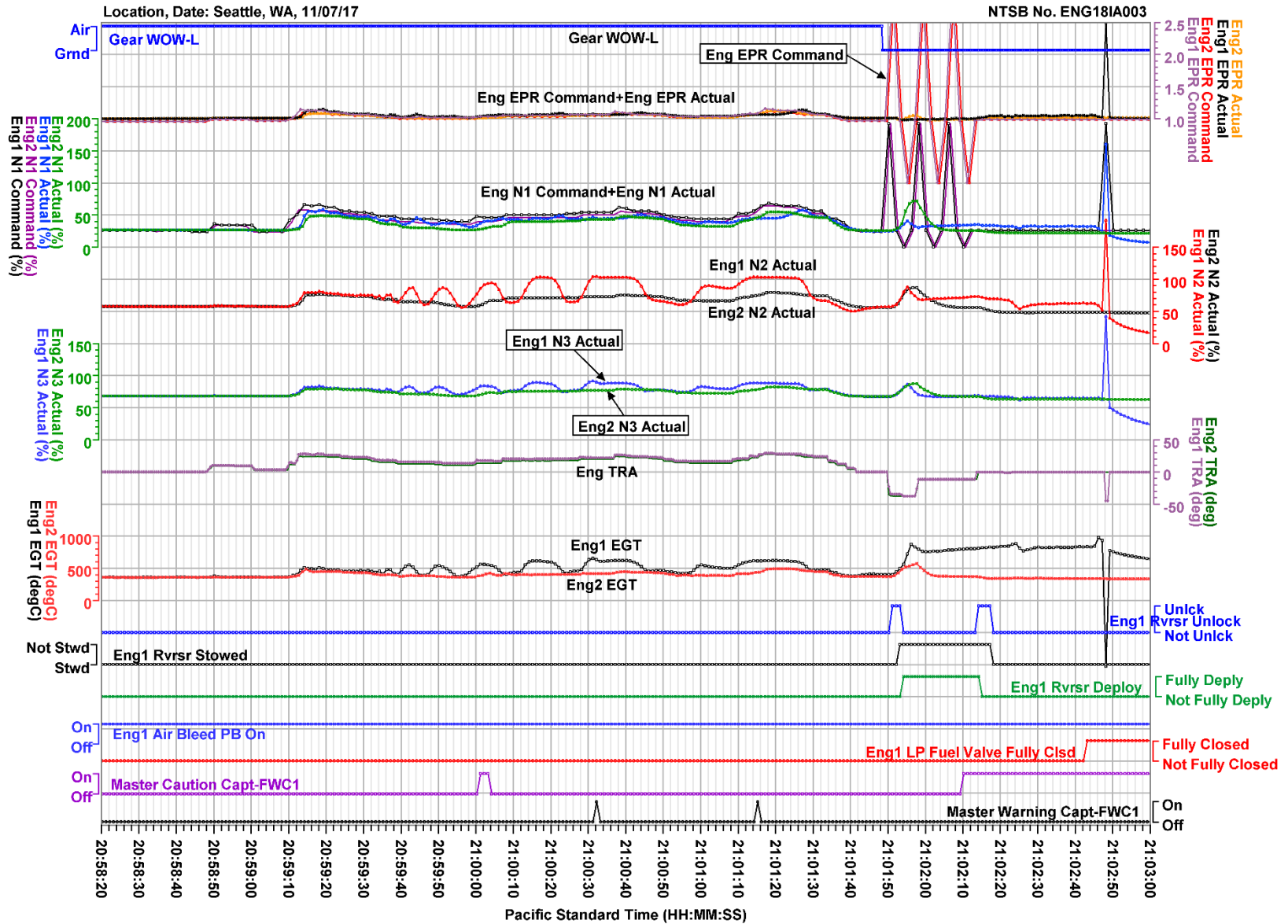


Final Approach from a pressure altitude of 2,652 feet through landing (4 min 40 sec)

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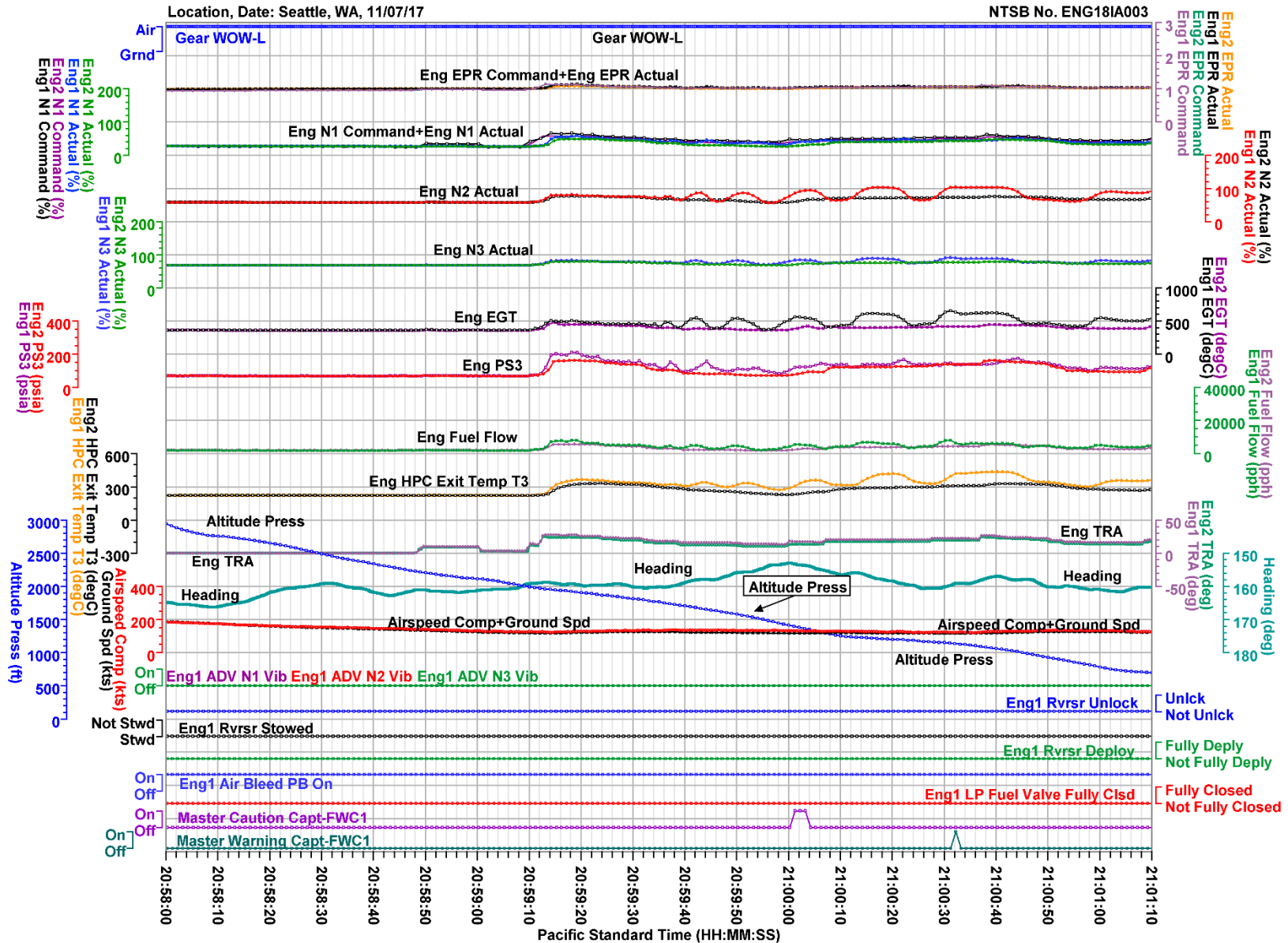
Figure 6. Plot of additional FDR parameters from 20:58:20 PST to 21:03:00 PST (4 minutes 40 seconds).



Final Approach from a pressure altitude of 2,652 feet through landing (4 min 40 sec)

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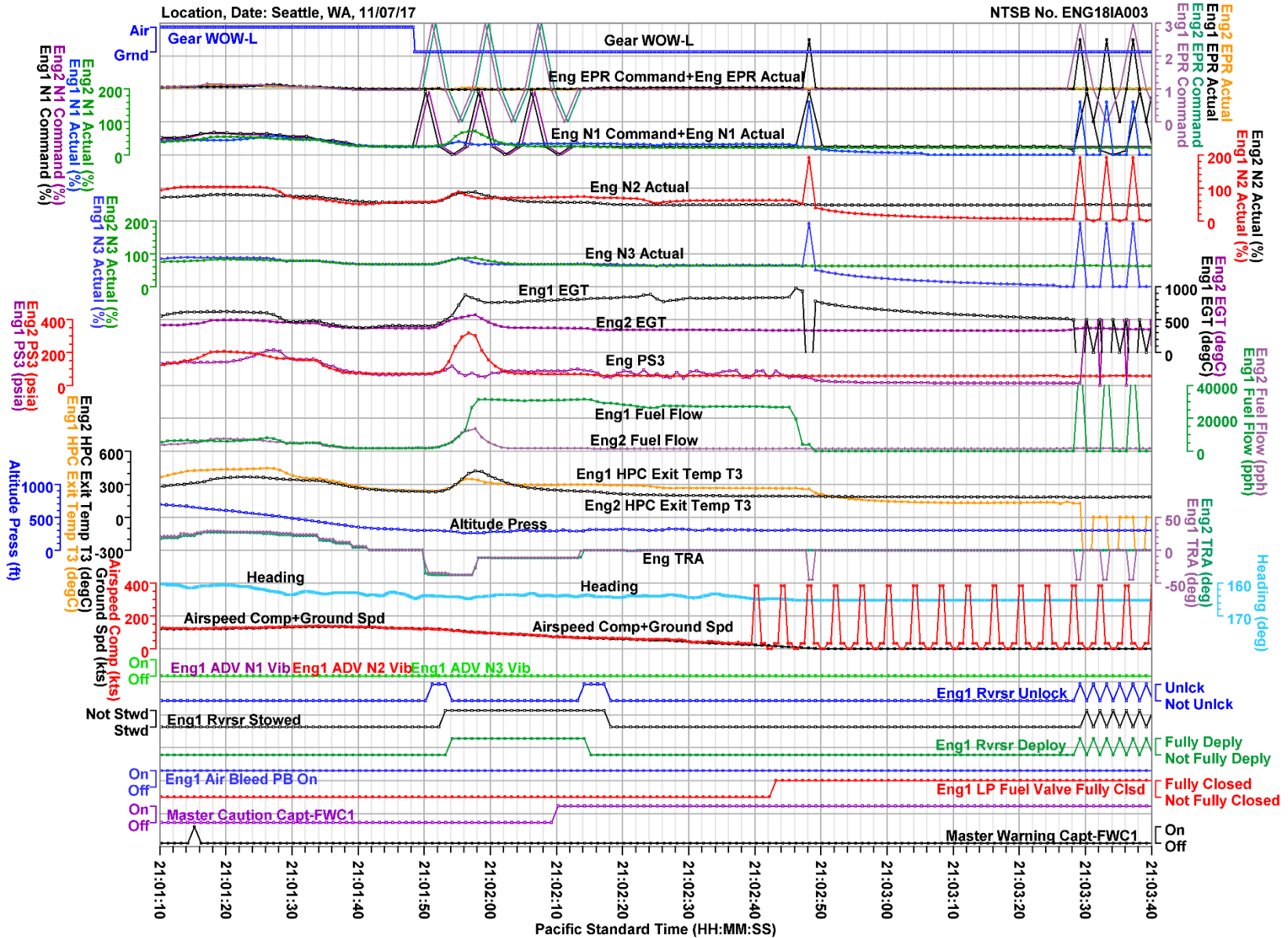
Figure 7. Plot of FDR parameters from at 20:58:00 PST to 21:01:10 PST (3 minutes 10 seconds).



Final approach from a pressure altitude of 2,940 feet to 692 feet (3 min 10 sec)

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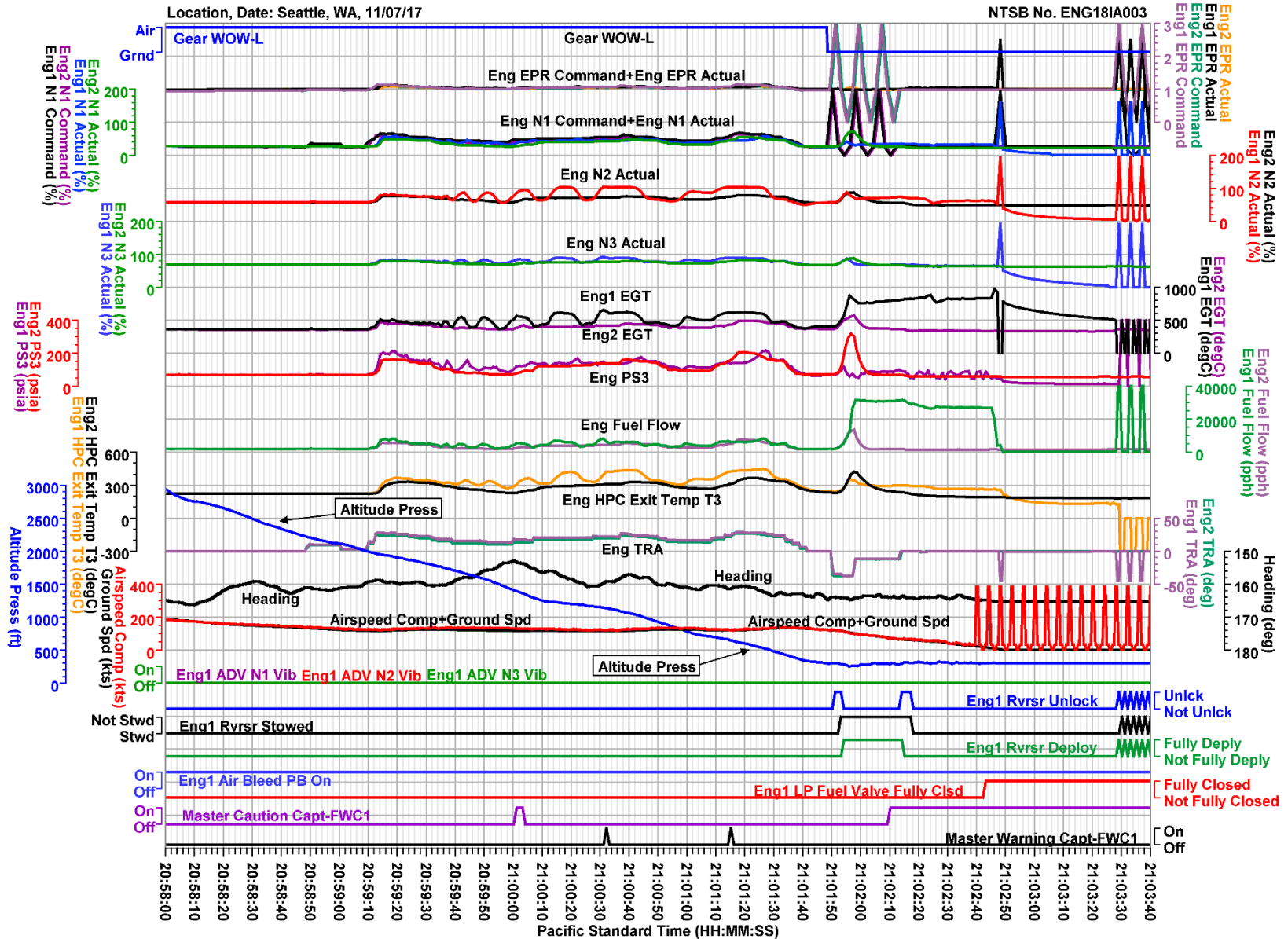
Figure 8. Plot of FDR parameters from 21:01:10 PST to 21:03:40 PST (2 minutes 30 seconds).



Final Approach from a pressure altitude of 684 feet through landing (2 min 30 sec)

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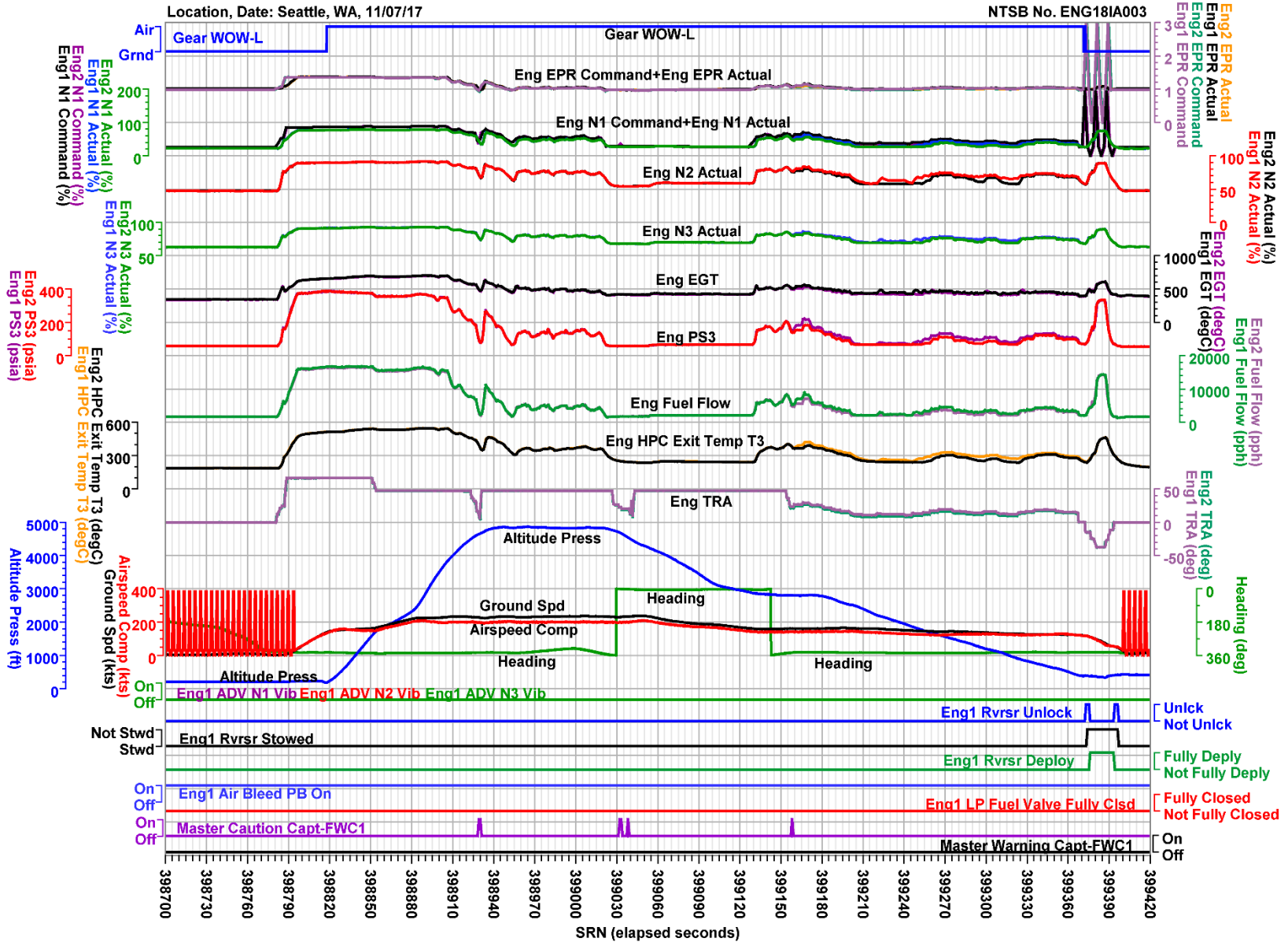
Figure 9. Plot of FDR parameters from at 20:58:00 PST to 21:03:40 PST (5 minutes 40 seconds).



Final approach from a pressure altitude of 2,940 feet through landing (5 min 40 sec)

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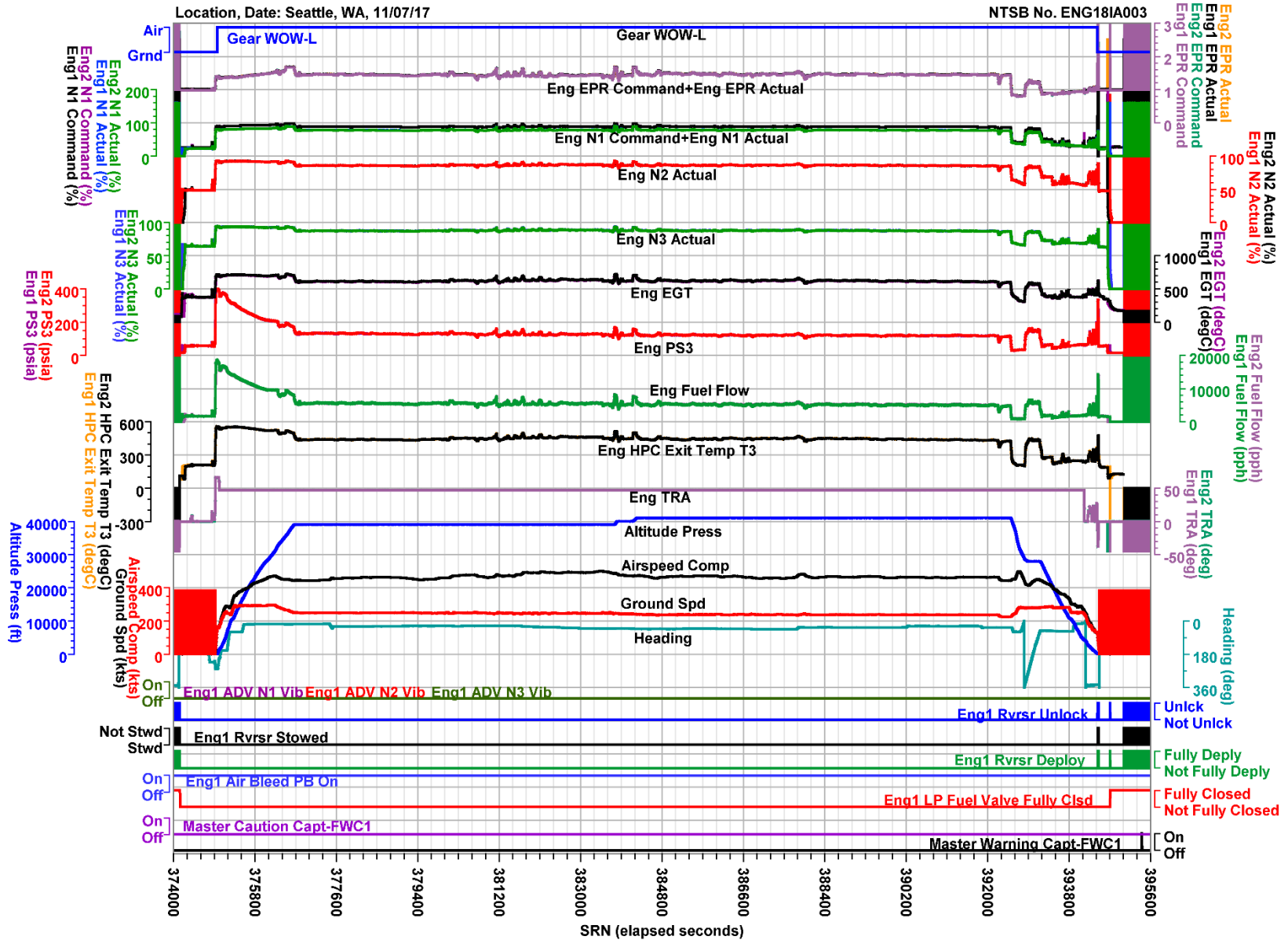
Figure 10. Plot of FDR parameters during first previous flight.



1st previous flight

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Figure 11. Plot of FDR parameters during 2<sup>nd</sup> previous flight.



2nd previous flight

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## APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the plot/table labels, parameter names, and units. Additionally, table A-2 describes the unit and discrete abbreviations used in this report.

**Table A-1. Verified and provided FDR parameters.**

Plot/Table Labels	Parameter Names	Units
Airspeed Comp <sup>A</sup>	Computed Airspeed	kts
Altitude Press	Pressure Altitude	ft
Eng1 ADV N1 Vib	Engine 1 Fan Speed Vibration Advisory	
Eng1 ADV N2 Vib	Engine 1 Intermediate Pressure Shaft Speed Vibration Advisory	
Eng1 ADV N3 Vib	Engine 1 High Pressure Shaft Speed Vibration Advisory	
Eng1 Air Bleed PB On	Engine 1 Air Bleed Push Button On	
Eng1 EGT <sup>A</sup>	Engine 1 Exhaust Gas Temperature	degC
Eng1 EPR Actual <sup>A</sup>	Engine 1 Engine Pressure Ratio Actual	
Eng1 EPR Command <sup>A</sup>	Engine 1 Engine Pressure Ratio Command	
Eng1 Fuel Flow <sup>A</sup>	Engine 1 Fuel Flow	pph
Eng1 HPC Exit Temp T3 <sup>A</sup>	Engine 1 High Pressure Compressor Exit Temperature T3	degC
Eng1 LP Fuel Valve Fully Clsd	Engine 1 Low Pressure Fuel Valve Fully Closed	
Eng1 N1 Actual <sup>A</sup>	Engine 1 Fan Speed Actual	%
Eng1 N1 Command <sup>A</sup>	Engine 1 Fan Speed Command	%
Eng1 N2 Actual <sup>A</sup>	Engine 1 Intermediate Pressure Shaft Speed Actual	%
Eng1 N3 Actual <sup>A</sup>	Engine 1 High Pressure Shaft Speed Actual	%
Eng1 PS3 <sup>A</sup>	Engine 1 High Pressure Compressor Discharge Pressure	psia
Eng1 Rvrsr Deploy <sup>A</sup>	Engine 1 Reverser Deployed	
Eng1 Rvrsr Stowed <sup>A</sup>	Engine 1 Reverser Stowed	
Eng1 Rvrsr Unlock <sup>A</sup>	Engine 1 Reverser Unlocked	
Eng1 TRA <sup>A</sup>	Engine 1 Throttle Resolver Angle	deg
Eng2 EGT <sup>A</sup>	Engine 2 Exhaust Gas Temperature	degC
Eng2 EPR Actual <sup>A</sup>	Engine 2 Engine Pressure Ratio Actual	
Eng2 EPR Command <sup>A</sup>	Engine 2 Engine Pressure Ratio Command	
Eng2 Fuel Flow <sup>A</sup>	Engine 2 Fuel Flow	pph
Eng2 HPC Exit Temp T3 <sup>A</sup>	Engine 2 High Pressure Compressor Exit Temperature T3	degC
Eng2 N1 Actual <sup>A</sup>	Engine 2 Fan Speed Actual	%
Eng2 N1 Command <sup>A</sup>	Engine 2 Fan Speed Command	%
Eng2 N2 Actual <sup>A</sup>	Engine 2 Intermediate Pressure Shaft Speed Actual	%
Eng2 N3 Actual <sup>A</sup>	Engine 2 High Pressure Shaft Speed Actual	%
Eng2 PS3 <sup>A</sup>	Engine 2 High Pressure Compressor Discharge Pressure	psia
Eng2 TRA <sup>A</sup>	Engine 2 Throttle Reverser Angle	deg
Gear WOW-L	Left Main Landing Gear Weight on Wheels	
Ground Spd	Ground Speed	kts
Heading	Magnetic Heading	deg
Master Caution Capt-FWC1	Master Caution Captain- Flight Warning Computer 1	
Master Warning Capt-FWC1	Master Warning Captain- Flight Warning Computer 1	
Time UTC Hrs	Coordinated Universal Time Hours	hrs
Time UTC Min	Coordinated Universal Time Minutes	min
Time UTC Sec	Coordinated Universal Time Seconds	sec

NOTE: <sup>A</sup> These parameters had an NCD pattern when on the ground.

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: Except for Eng1 EPR Actual, Eng2 EPR Actual, Eng1 EPR command, and Eng2 EPR command, parameters with a blank unit description in table A-1 are discrettes. 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.

**Table A-2. Unit and discrete abbreviations.**

<b>Unit and discrete Abbreviations</b>	<b>Descriptions</b>
deg	degrees
degC	degrees Celsius
ft	feet
Grnd	Ground
hrs	hours
kts	knots
min	minutes
pph	pounds per hour
psia	pounds per square inch absolute
sec	seconds
Stwd	Stowed
Unlck	Unlocked