National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

WPR24FA004

ENGINE DATA MONITOR

Specialist's Factual Report

July 22, 2024

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A. ACCIDENT

Location: Newberg, Oregon
Date: October 3, 2023
Time: 1847 Pacific daylight time (PDT)
Airplane: Piper PA-44-180, Hillsboro Aero Academy LLC, N8360K

B. ENGINE DATA MONITOR SPECIALIST

Specialist: Steven Smith
Mechanical Engineer (Recorder Specialist)
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A group was not convened. The NTSB Vehicle Recorder Division received the following engine data monitor (EDM):

Recorder Manufacturer/Model: JPI EDM-960
Recorder Serial Number: 06099

1.0 JPI EDM-960 Description

The J. P. Instruments EDM-960 is a panel mounted display that the operator can monitor and record multiple engine parameters related to twin engine operations and GPS parameters, if connected. Depending on the installation, engine parameters monitored can include:

- Exhaust Gas Temperature (EGT)
- Cylinder Head Temperature (CHT)
- Oil Pressure and Temperature
- Manifold Pressure
- Outside Air Temperature
- Turbine Inlet Temperature
- Engine Revolutions per Minute (RPM)
- Compressor Discharge Temperature
- Fuel Flow
- Fuel Pressure
- Fuel Level
- Carburetor Temperature
- Battery Voltage

The unit can also calculate, in real-time, horsepower, fuel used, shock cooling rate, and EGT differentials between the highest and lowest cylinder temperatures. The calculations are also based on the aircraft installation.

The unit contains non-volatile memory for data storage of the parameters recorded and calculated.[1] Data recording typically begins when EGT's are greater than 500°F or RPM is greater than 500 rpm. The rate at which the data is stored is selectable by the operator from 2 to 500 seconds per sample. The memory can store up to 100 hours of data at a 6 second sample rate. For a non-damaged unit, the data can be downloaded by the operator using a USB flash drive and following the manufacturer's instructions.

1.1 JPI EDM-960 Data Recovery

Upon arrival at the NTSB Vehicle Recorder Laboratory, the device had sustained significant impact damage, as shown in figure 1. The memory chip was identified and removed from the unit. The raw binary data was extracted from the memory chip and was converted into engineering units using laboratory tools.

Figure 1. Front (left) and back (right) of JPI EDM-960 as received by the NTSB Vehicle Recorder Laboratory.

1.2 JPI EDM-960 Data Description

The data downloaded from the EDM included 44 sessions from July 21, 2023, to October 3, 2023. The last session recorded on October 3, 2023, was identified as the accident flight. The accident recording was 48 minutes and 48 seconds long and ended shortly before the aircraft impacted terrain. The Automatic Dependent Surveillance – Broadcast (ADS-B) data reported an additional 18 seconds of data after the JPI EDM-960 recording ended. The JPI EDM-960 data were sampled every 6 seconds.

[1] Non-volatile memory is semiconductor memory that does not require external power for data retention.

1.2.1 JPI EDM-960 Parameters Provided

Table 1 lists the JPI EDM-960 parameters verified and provided in this report. Note, this aircraft is a twin-engine aircraft with the number one and number two engine denoted as the left and right, respectively. On the plots, the parameters will be denoted with either a "L" or "R" for left or right, respectively.

Table 1. JPI EDM-960 data parameters provided.

Parameter Name (unit)	Parameter Description (unit)
Alt (ft)	Pressure Altitude (feet)
CHT#L/R (degF)	Left or Right Engine Cylinder Head Temperature #[2] (degrees Fahrenheit)
EGT#L/R (degF)	Left or Right Engine Exhaust Gas Temperature # (degrees Fahrenheit)
FF1L/R (gph)	Left or Right Fuel Flow (gallons per hour)
FPL/R (psi)	Left or Right Fuel Pressure (pounds per square inch)
GSPD (kts)	Groundspeed (knots)
MAPL/R (inHg)	Left or Right Engine Manifold Pressure (inches of Mercury)
RPML/R (rpm)	Left or Right Engine Revolutions per Minute (revolutions per minute)
OILPL/R (psi)	Left or Right Oil Pressure (pounds per square inch)
OILTL/R (degF)	Left or Right Oil Temperature (degrees Fahrenheit)

1.3 JPI EDM-960 Time Correlation

Time on the JPI EDM-960 was recorded in seconds from startup. An offset of 64,652 seconds was applied to correct for both time correlation to the accident and change time displayed from UTC to local time (PDT). The offset was determined by correlating the altitude from the JPI EDM-960 to the altitude from the ADS-B during takeoff and throughout the flight.

D. FIGURES AND TABULAR DATA

Figures 2 to 7 contain EDM data recorded during the event on October 3, 2023. All the parameters listed in table 1 are plotted.

Figures 2 and 3 are time history plots of left engine parameters for the entire flight (18:15:00 PDT to 18:47:00 PDT) and the last 2 minutes of the flight (18:44:20 PDT to 18:46:20 PDT), respectively. Figures 4 and 5 are time history plots of right engine parameters for the entire flight (18:15:00 PDT to 18:47:00 PDT) and the last 2 minutes of the flight (18:44:20 PDT to 18:46:20 PDT), respectively. Figures 6 and 7 are time history plots of overlayed engine parameters for the entire flight

[2] This aircraft engine is configured with 4 cylinders. In the data plots, the '#' is replaced with the appropriate cylinder ID.

(18:15:00 PDT to 18:47:00 PDT) and the last 2 minutes of the flight (18:44:20 PDT to 18:46:20 PDT), respectively.

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.

The EDM data indicated the following sequence of events:

- **18:17:20 PDT:** The aircraft began takeoff roll.
- **18:22:20 PDT:** Pressure altitude was 4072 ft.
- **18:29:08 PDT:** The aircraft began to climb from 4354 ft.
- **18:38:20 PDT:** The aircraft began a descent from 7091 ft.
- **18:44:50 PDT:** RPM left and right were 2358 rpm and 2366 rpm, respectively. MAP left and right were 22.5 inHg and 22.4 inHg, respectively. Fuel flow left and right were 10.4 gph and 10.2 gph, respectively.
- **18:44:56 PDT:** RPM left and right were 2335 rpm and 2326 rpm, respectively. MAP left and right were 16.1 inHg and 17.3 inHg, respectively. Fuel flow left and right were 9.1 gph and 9.4 gph, respectively.
- **18:45:08 PDT:** RPM left and right were 2540 rpm and 2457 rpm, respectively. MAP left and right were 14.2 inHg and 14.7 inHg, respectively. Fuel flow left and right were 7.1 gph and 7.6 gph, respectively.
- **18:45:26 PDT:** RPM left and right were 1495 rpm and 2639 rpm, respectively. MAP left and right were 4.5 inHg and 24.1 inHg, respectively. Fuel flow left and right were 1.7 gph and 10.4 gph, respectively.
- **18:45:56 PDT:** Pressure altitude was 5816 ft. RPM left and right were 840 rpm and 1947 rpm, respectively. MAP left and right were 6.7 inHg and 4.4 inHg, respectively. Fuel flow left and right were 3.4 gph and 12.7 gph, respectively. The aircraft began to descend for the remainder of the recording.
- **18:46:20 PDT:** The last recorded JPI EDM-960 data point. Pressure altitude was 4796 ft. RPM left and right were 0 rpm and 497 rpm, respectively. MAP left and right were 26.5 inHg and 12.2 inHg, respectively. Fuel flow left and right were 1.2 gph and 5.5 gph, respectively.

The corresponding tabular data used to create figures 2 to 7 are provided in electronic comma-separated value (CSV) format as attachment 1 to this report.

Figure 8 and 9 are graphical overlays derived from the ADS-B data and generated using Google Earth presenting the entire accident flight from Portland-Hillsboro Airport (KHIO) and approximately the final minute of the recorded data, respectively. Weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

The corresponding tabular data used to create figures 8 and 9 are provided in CSV format as attachment 2 to this report.

Submitted by:

Steven Smith
Mechanical Engineer (Recorder Specialist)

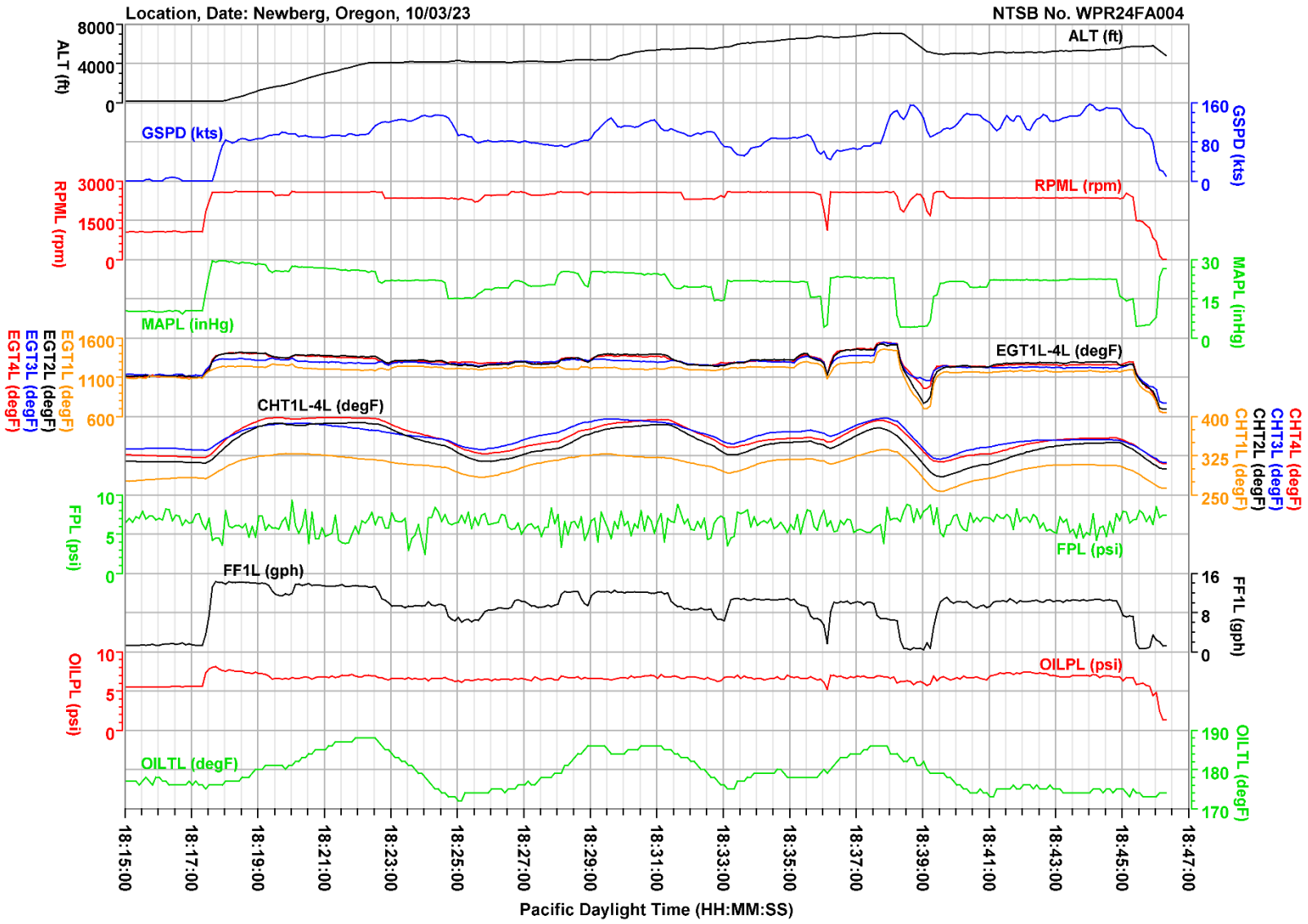

Figure 2. Time history plot of left engine parameters for the entire flight from 18:15:00 PDT to 18:47:00 PDT.

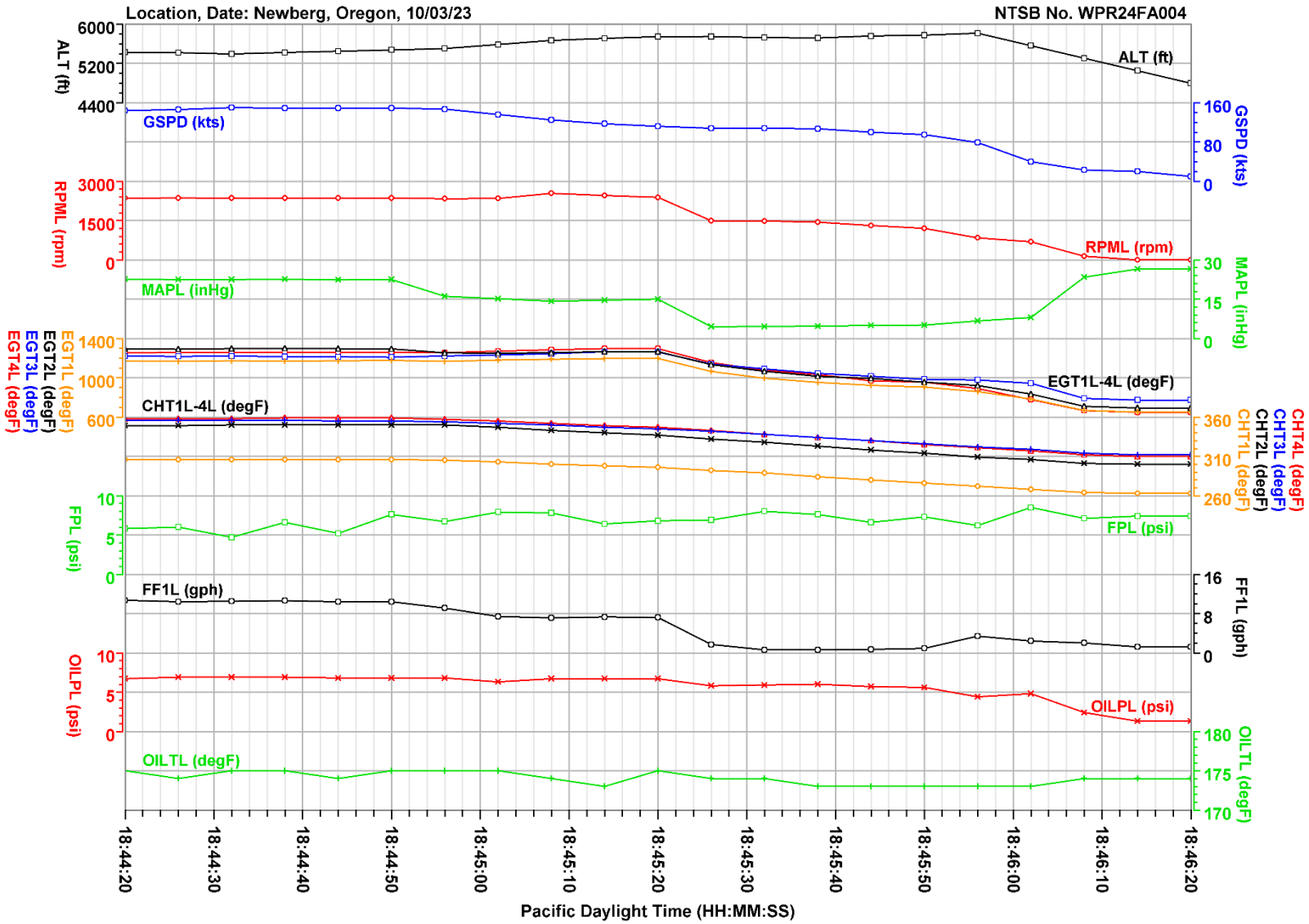

Figure 3. Time history plot of left engine parameters for the last 2 minutes of the flight from 18:44:20 PDT to 18:46:20 PDT.

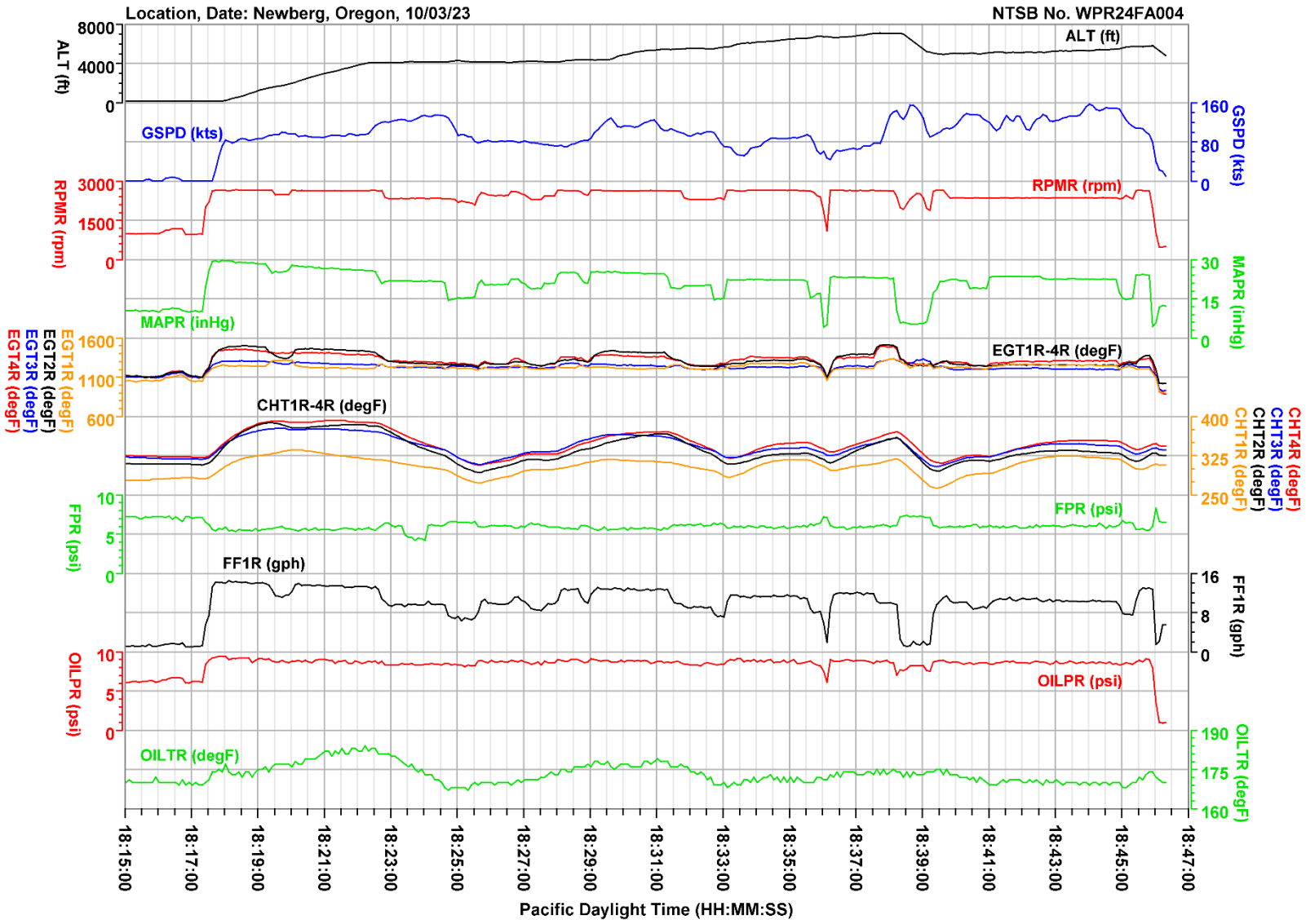

Figure 4. Time history plot of right engine parameters for the entire flight from 18:15:00 PDT to 18:47:00 PDT.

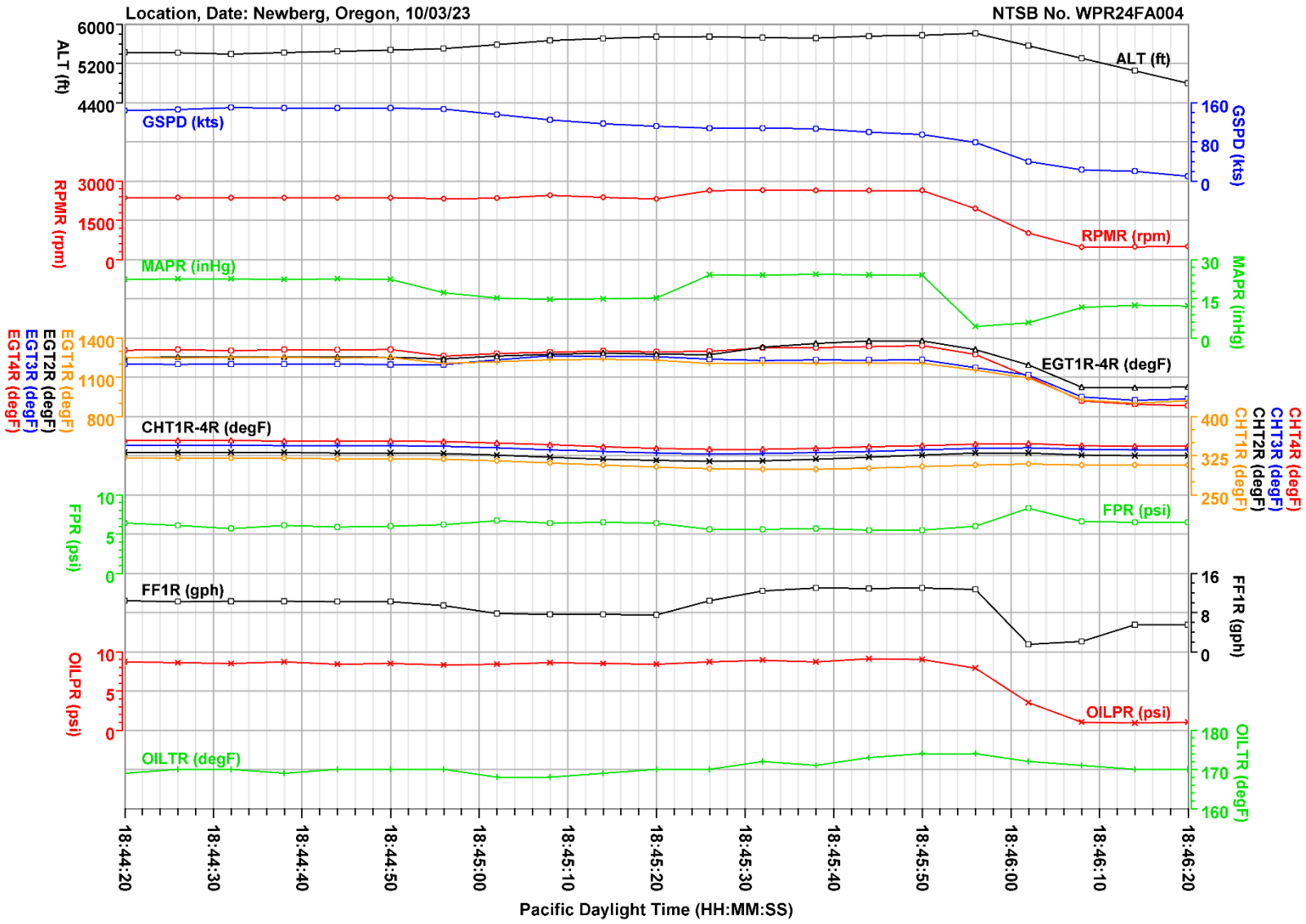

Figure 5. Time history plot of right engine parameters for the last 2 minutes of the flight from 18:44:20 PDT to 18:46:20 PDT.

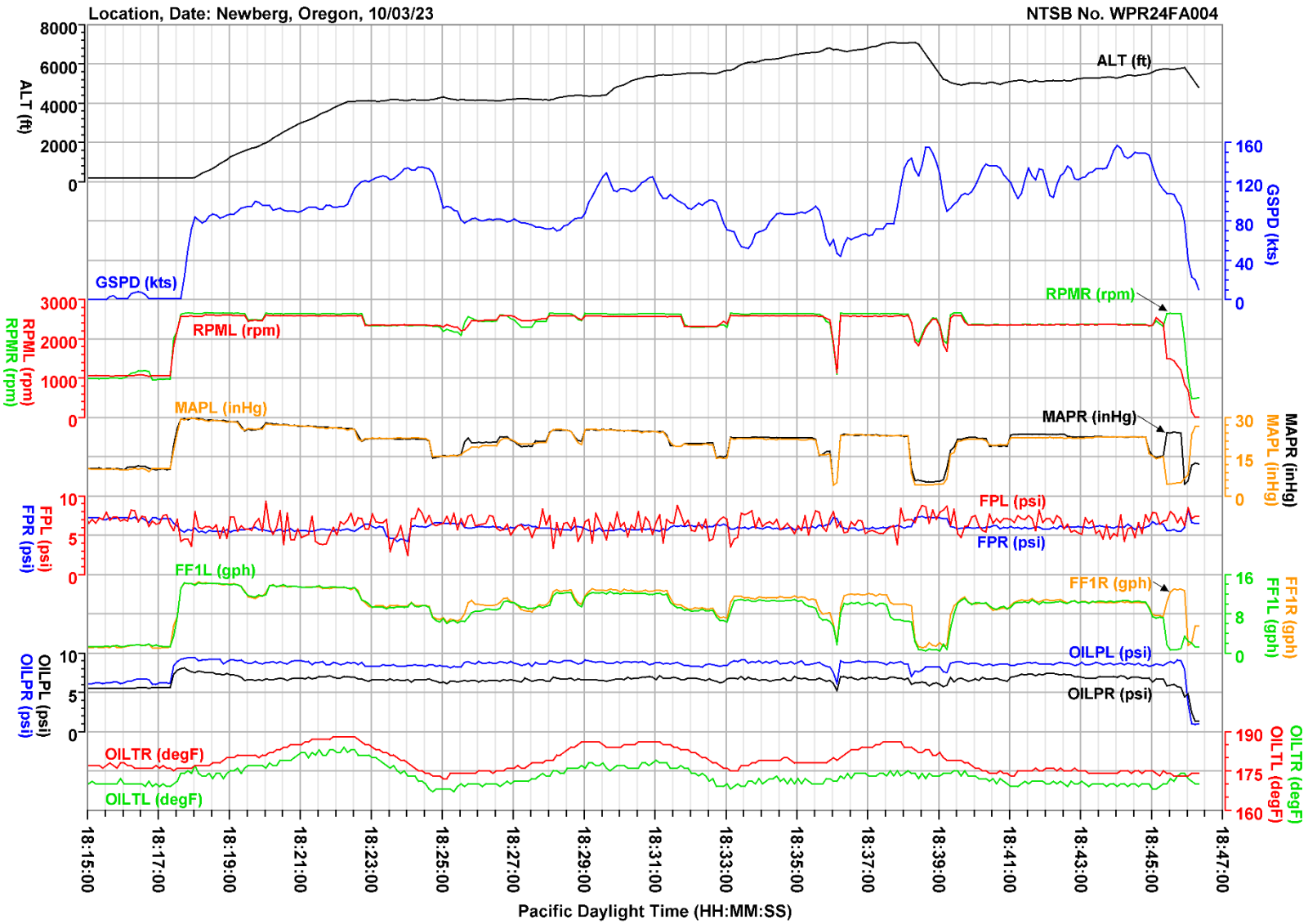

Figure 6. Time history plot of overlayed engine parameters for the entire flight from 18:15:00 PDT to 18:47:00 PDT.

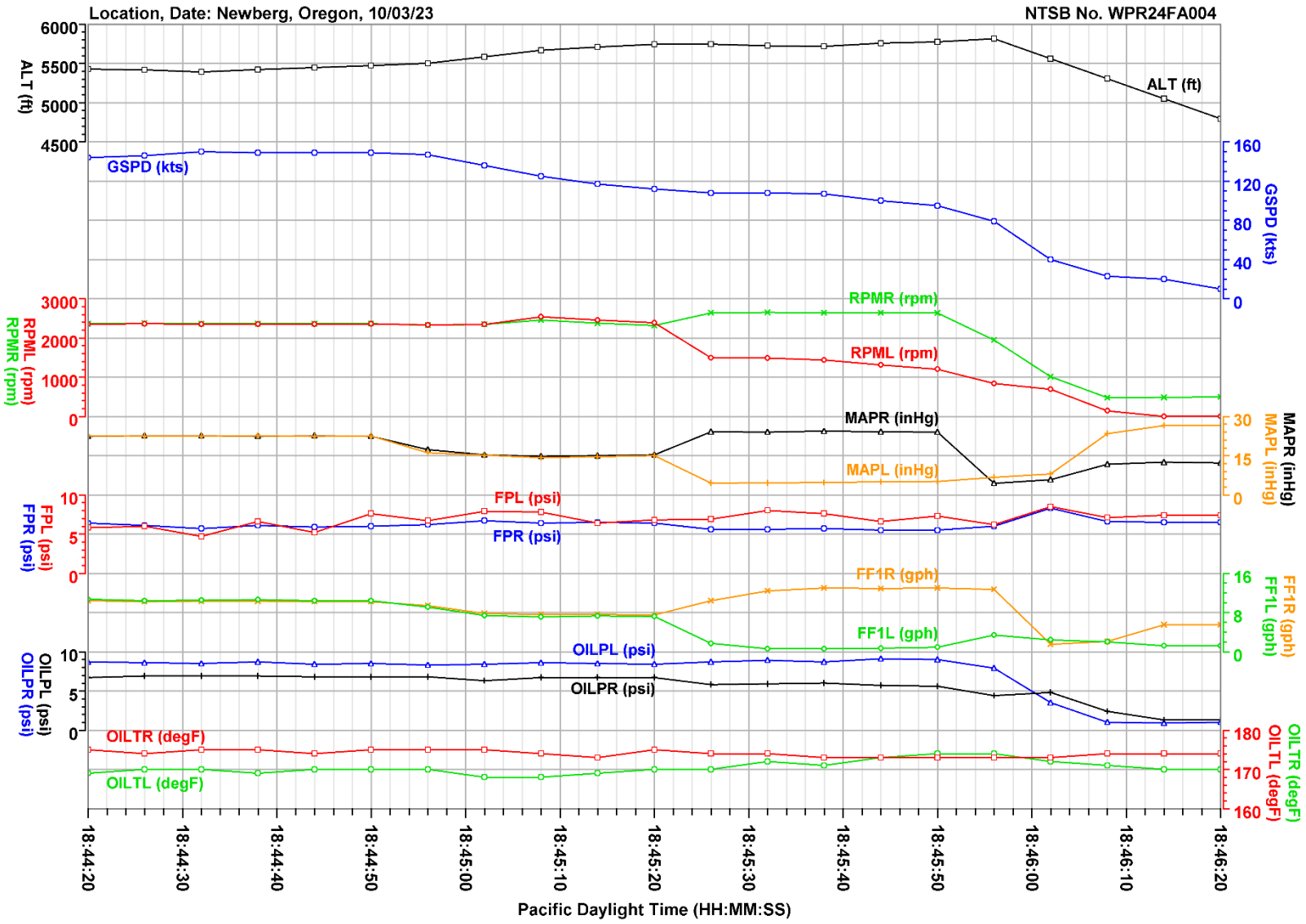

Figure 7. Time history plot of overlayed engine parameters for the last 2 minutes of the flight from 18:44:20 PDT to 18:46:20 PDT.

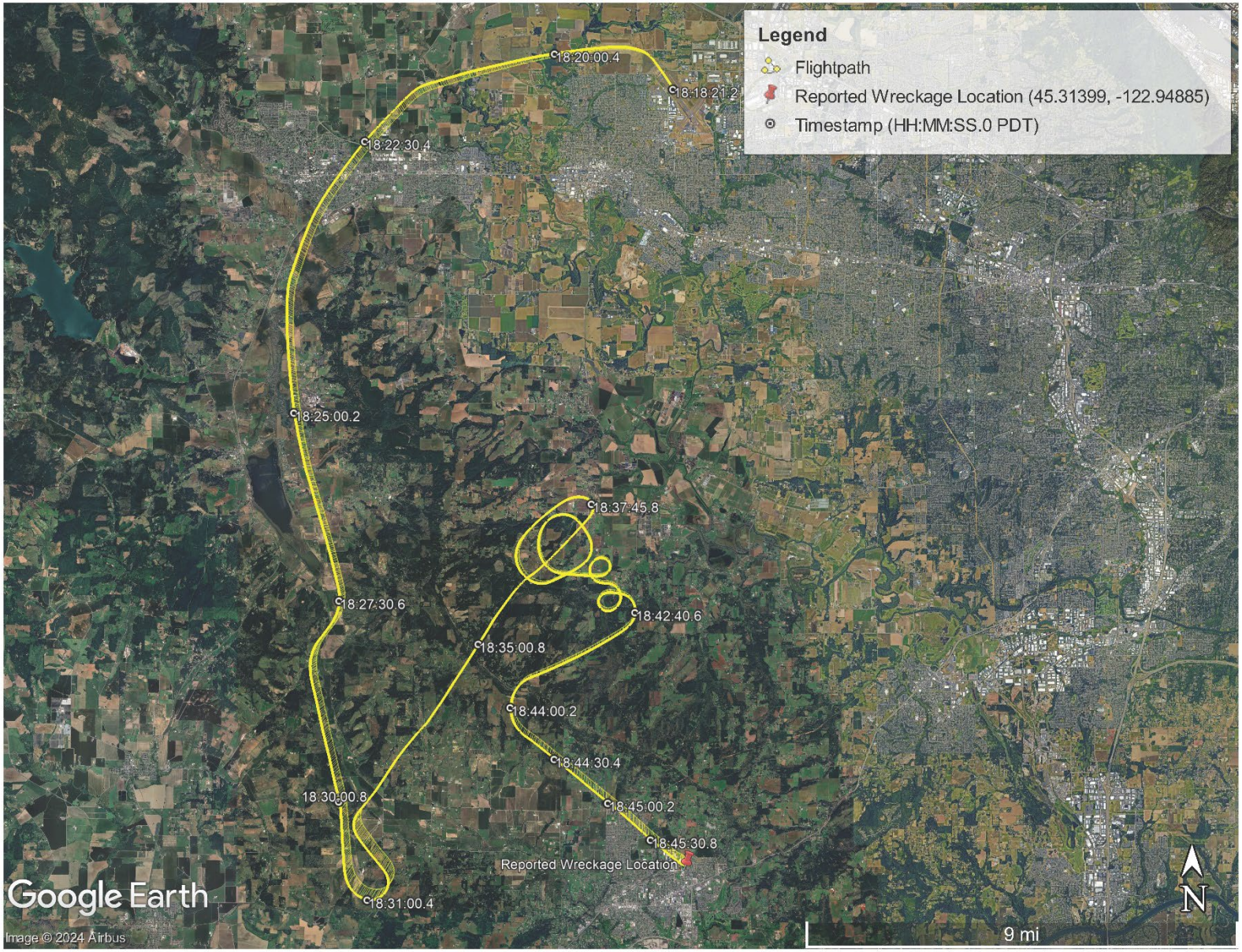

Figure 8. Google Earth overlay of ADS-B data for the entire accident flight.

Figure 9. Google Earth overlay of ADS-B data for approximately the last minute.