

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

May 19, 2022

Engine Data Monitor (EDM)

Specialist's Factual Report
By Sean Payne

1. EVENT SUMMARY

Location: La Belle, FL
Date: May 6, 2021
Aircraft: Aerostar 600
Registration: C-FAAZ
Operator: Private
NTSB Number: ERA21FA212

2. DETAILS OF INVESTIGATION

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

Recorder Manufacturer/Model: **JPI EDM 760**
Recorder Serial Number: **03877**

2.1. EDM 760 Description

The J. P. Instruments EDM-760 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to twin engine operations. Depending on the installation engine parameters monitored, for both engines, 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
- Compressor Discharge Temperature

- Fuel Flow
- 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. 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 20 hours of data at a 6 second sample rate. The data can then be downloaded by the operator using the J.P. Instruments software.

2.1.1. Data Recovery

The unit appeared undamaged, and powered normally on a test bench. Figure 1 is photo of the unit. The JPI file was extracted by the Investigator-In-Charge, from the JPI unit directly. The JPI file contained data for the last 12 power cycles of the unit when installed in the accident aircraft. The JPI was transported to the NTSB Vehicle Recorder Laboratory and the manufacturer's software was used to convert the file to a form that can be plotted by NTSB software.



Figure 1. The JPI EDM 760 as received.

2.1.2. Data Description

The JPI file contained 12 power cycles worth of data. The event flight was the last flight of the recording, and its duration was approximately a half hour in duration. The recording of the previous flight to the accident was also reviewed and is discussed below.

2.1.3. Engineering Units Conversions

The engineering unit conversions used for the data contained in this report are based on documentation from the manufacturer of the EDM.

Appendix A lists the EDM parameters verified and provided in this report.

2.2. Time Correlation

The EDM records time with the first data sample based on the unit's internal clock. This clock is set and updated by the operator.

Correlation of the EDM data to the event local time, EDT, was established by using the recorded Time and then applying an additional -15,088 second offset to adjust to local time. The offset was created by taking the last data point from the unit and offsetting it to the reported accident time. Additionally, the overall length of the recorded session was in agreement with the length of the accident flight. Due to the data sampling and power schema of the JPI device, this correlation could be slightly inaccurate. Therefore, for the rest of this report, all times are referenced as EDT, not recorded time.

2.3. Plots and Corresponding Tabular Data

The following four figures contain EDM data recorded during the accident flight power cycle and a previous power cycle of the unit both conducted on May 6, 2021.

Figure 2 is a plot of a power cycle of the unit, previous to the power cycle containing the accident. The recording began around 14:05 EDT on the accident day (May 6, 2021). The data described nominal operations for nearly a 30-minute period. No anomalies were noted.

Figure 3 is a plot of the power cycle associated with the accident flight. The recording began around 14:48 EDT on May 6, 2021, and ended around 15:20 EDT. Note that the unit's internal clock was correlated to the accident time, so the exact time correlation may be slightly inaccurate. This data is discussed in greater detail below.

Figure 4 is an expanded timeframe plot of the power cycle associated with the accident flight. The time interval is from 15:04 EDT to 15:20 EDT. The following events were noted in chronological order:

- 15:05:18 – Left engine EGT values indicate a power loss of the left engine
- 15:07:30 – Recorded battery voltage shows a perturbation
- 15:09:42 – Left engine EGT values indicate the left engine begins making power

For the next approximate seven and a half minutes, recorded engine data values appear nominal. The following events were then noted:

- 15:17:08 - Right engine EGT values indicate a power loss of the right engine
- 15:17:12 - Left engine EGT values indicate a power loss of the left engine
- 15:18:24 - Recorded battery voltage shows a perturbation

Around the same time as the battery perturbation, EGT and fuel flow values show a slight rise for the left engine. Corresponding data for the left engine shows that the engine never regained power.

Data also show that the right engine never regained power.

The recording ended at 15:20 EDT.

Figure 5 is a hyper-expanded plot showing data for the time range of 15:15 to 15:20. The purpose of the plot is to show, in detail, the behavior of the EGT values for each engine. The following is noted:

- 15:15:36 – Values for right engine EGT show a more gradual rise and subsequent more gradual decline. The data shows the right engine ultimately stopped producing power.
- 15:17:00 – Values for the left engine EGT show a quicker rise and a subsequent quicker decline (as compared to the right engine EGT values).
- 15:18:24 – A recorded battery voltage perturbation in combination with slight EGT and fuel flow rise for the left engine. Data show that neither engine regained power.

Figure 6 is an overview of the aircraft's ADS-B data track with critical times from the engine monitor plots annotated. The arrows indicate the direction of flight. The overview is plotted on Google Earth, note that weather and lighting conditions may not be as they appear at the time of the accident flight.

Figure 7 is an overview of the aircraft's ADS-B data track with critical times from the engine monitor plots annotated. The portion of the flight track is plotted where the aircraft changed heading. The arrows indicate the direction of flight.

Figure 8 is an overview of the aircraft's ADS-B data track with critical times from the engine monitor plots annotated. The end portion of the ADS-B track is plotted, along with a pin for the GPS coordinates of the wreckage location. The arrows indicate the direction of flight.

The corresponding tabular data used to create figure 1 is attached to this report as attachment 1.

The corresponding tabular data used to create figures 2-4 is attached to this report as attachment 2.

plots are provided in electronic (*.csv) format as Attachment 1 to this report.¹

¹ Comma Separated Value format.

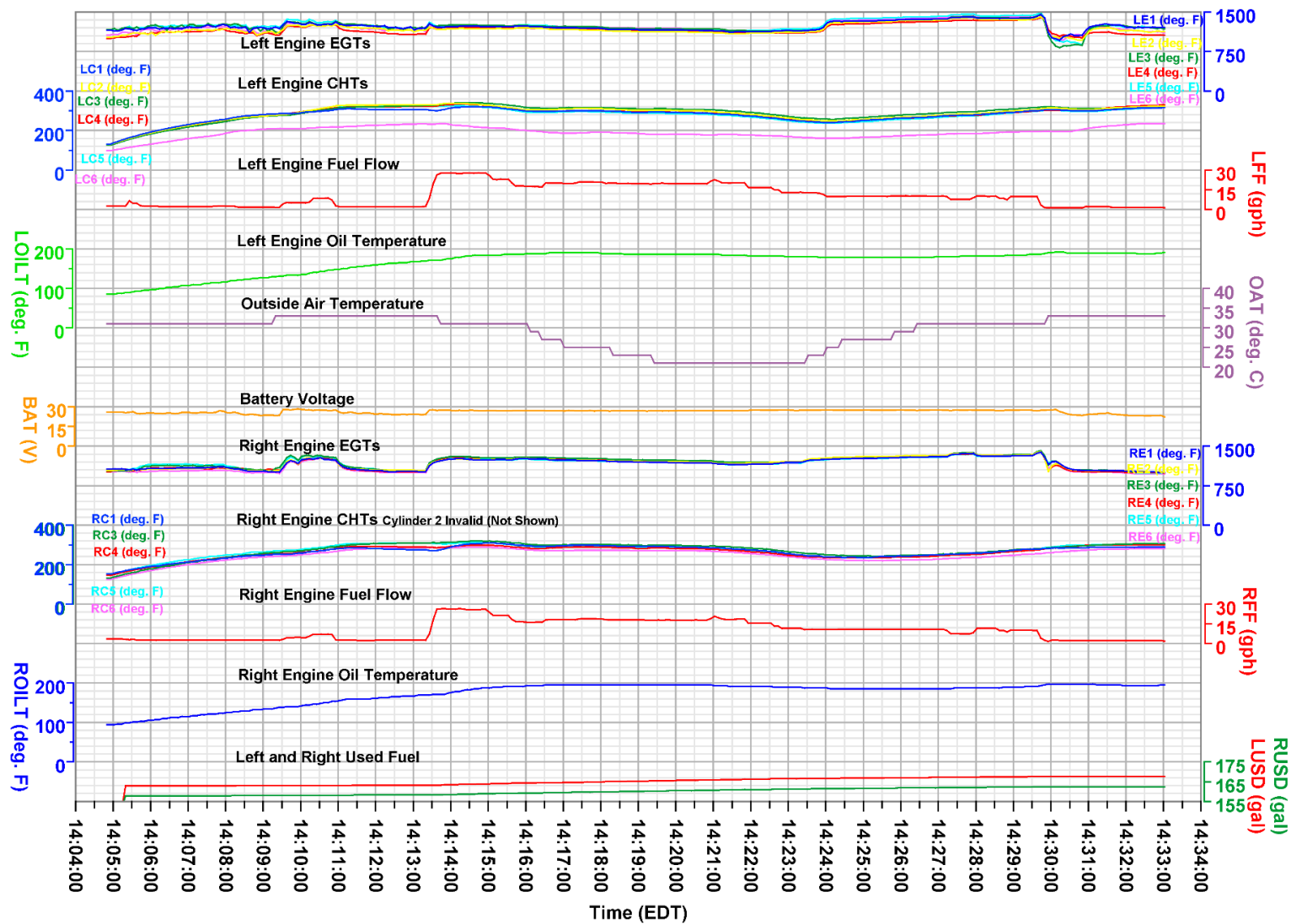


Figure 2. Plot of basic engine parameters for the previous flight to the accident which occurred on May 6, 2021.

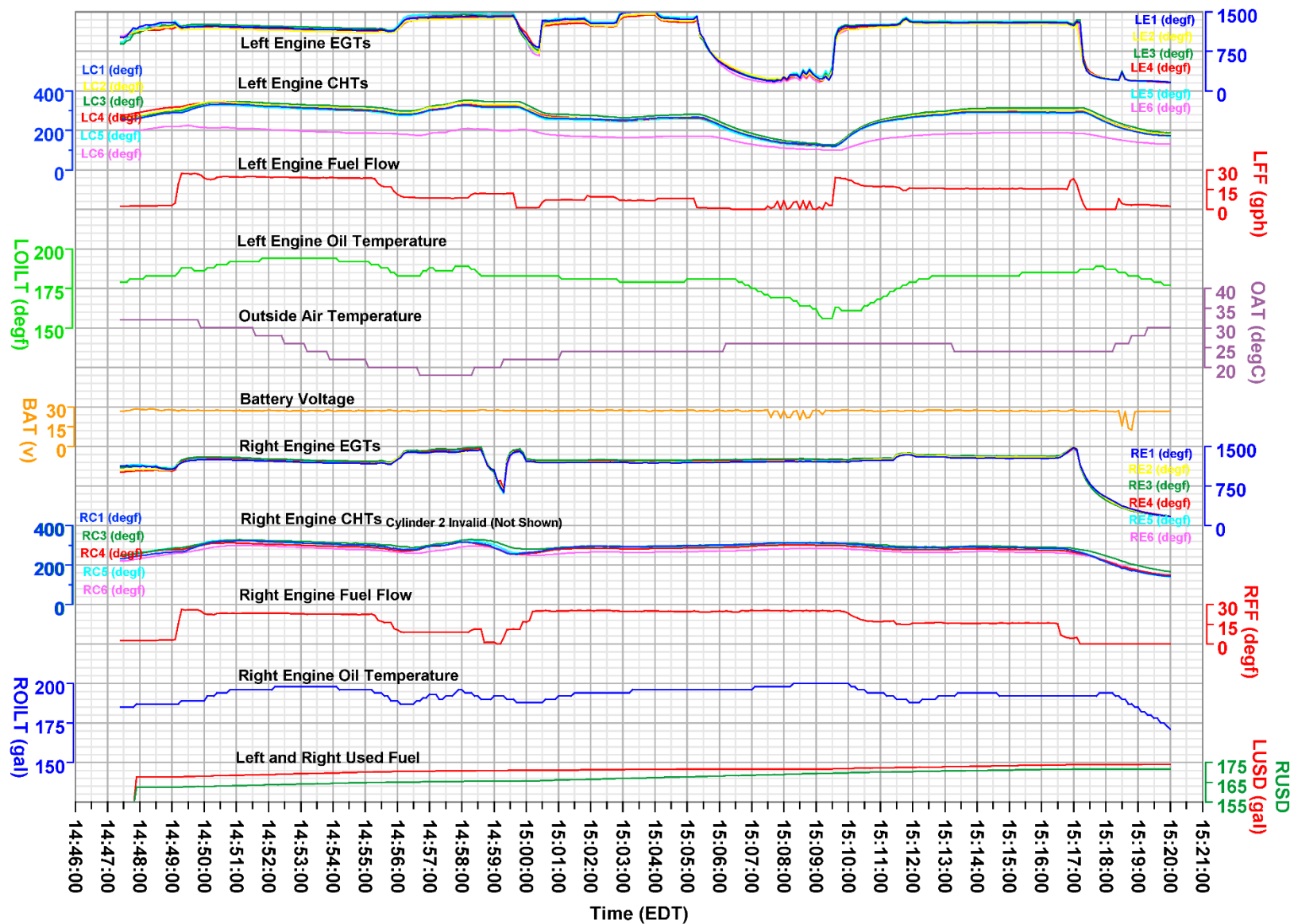


Figure 3. Plot of basic engine parameters for the entire accident flight on May 6, 2021.

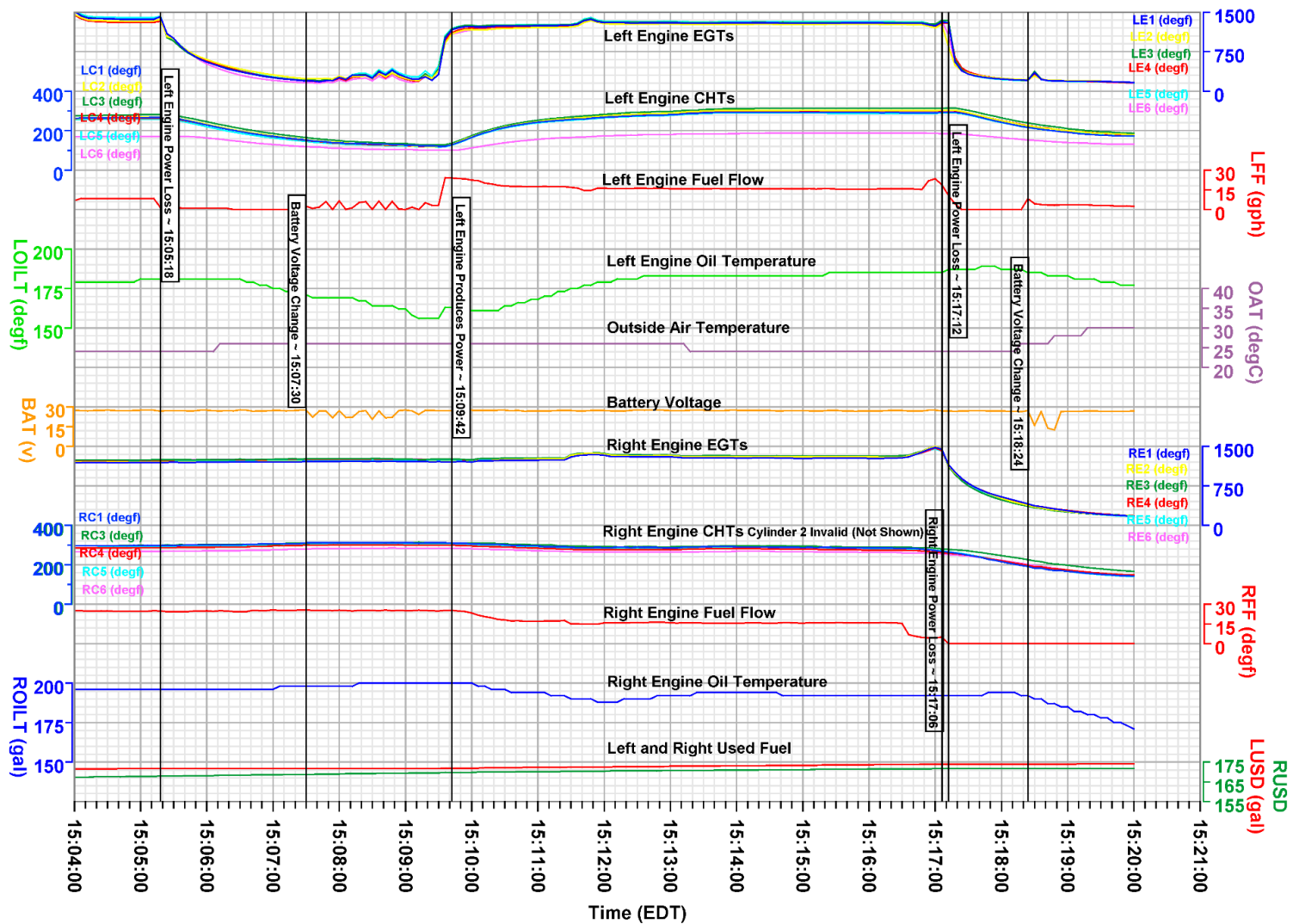


Figure 4. Plot of basic engine parameters for the last 17 minutes of the accident flight.

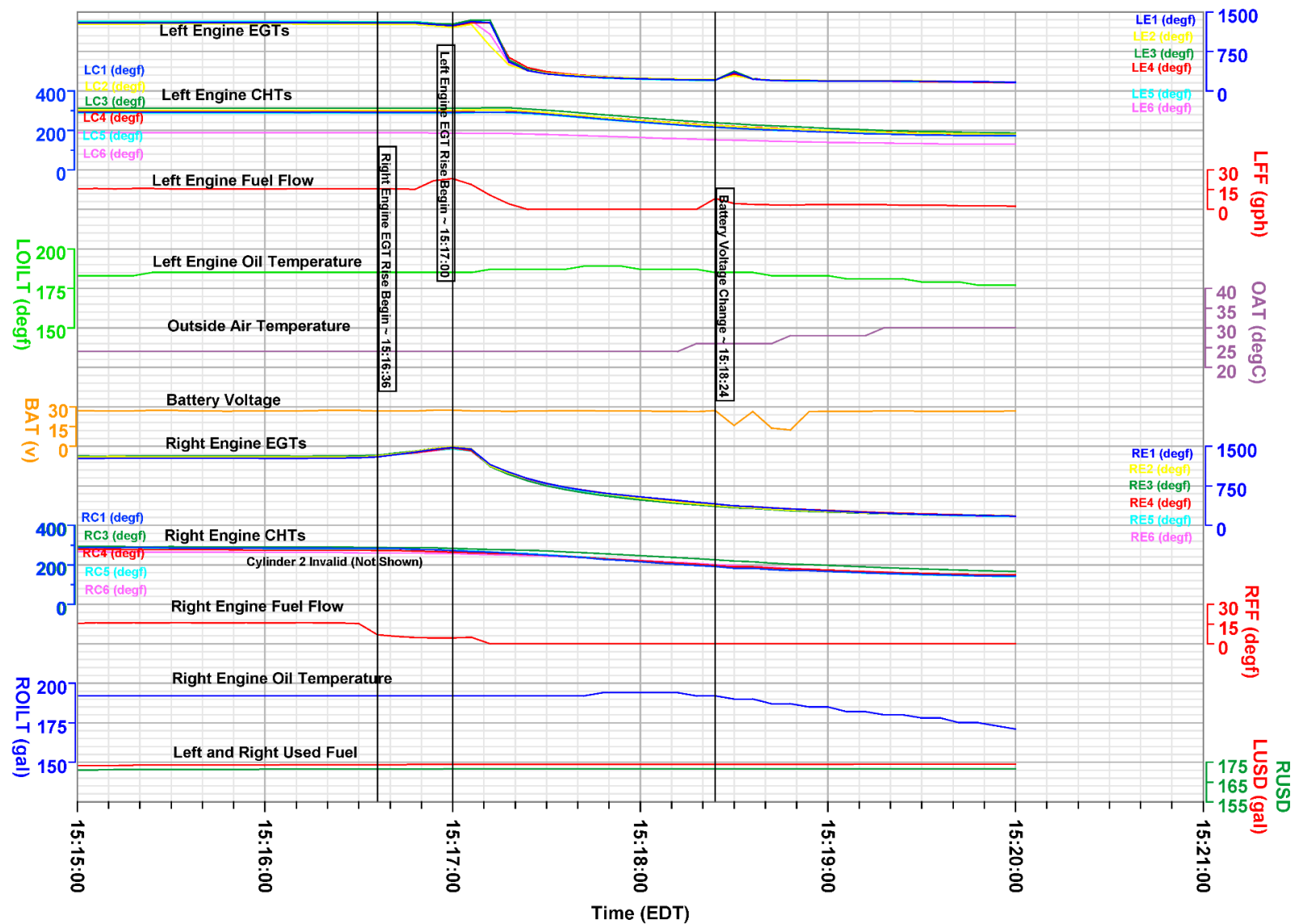


Figure 5. Plot of basic engine parameters for the last 5 minutes of the accident flight.

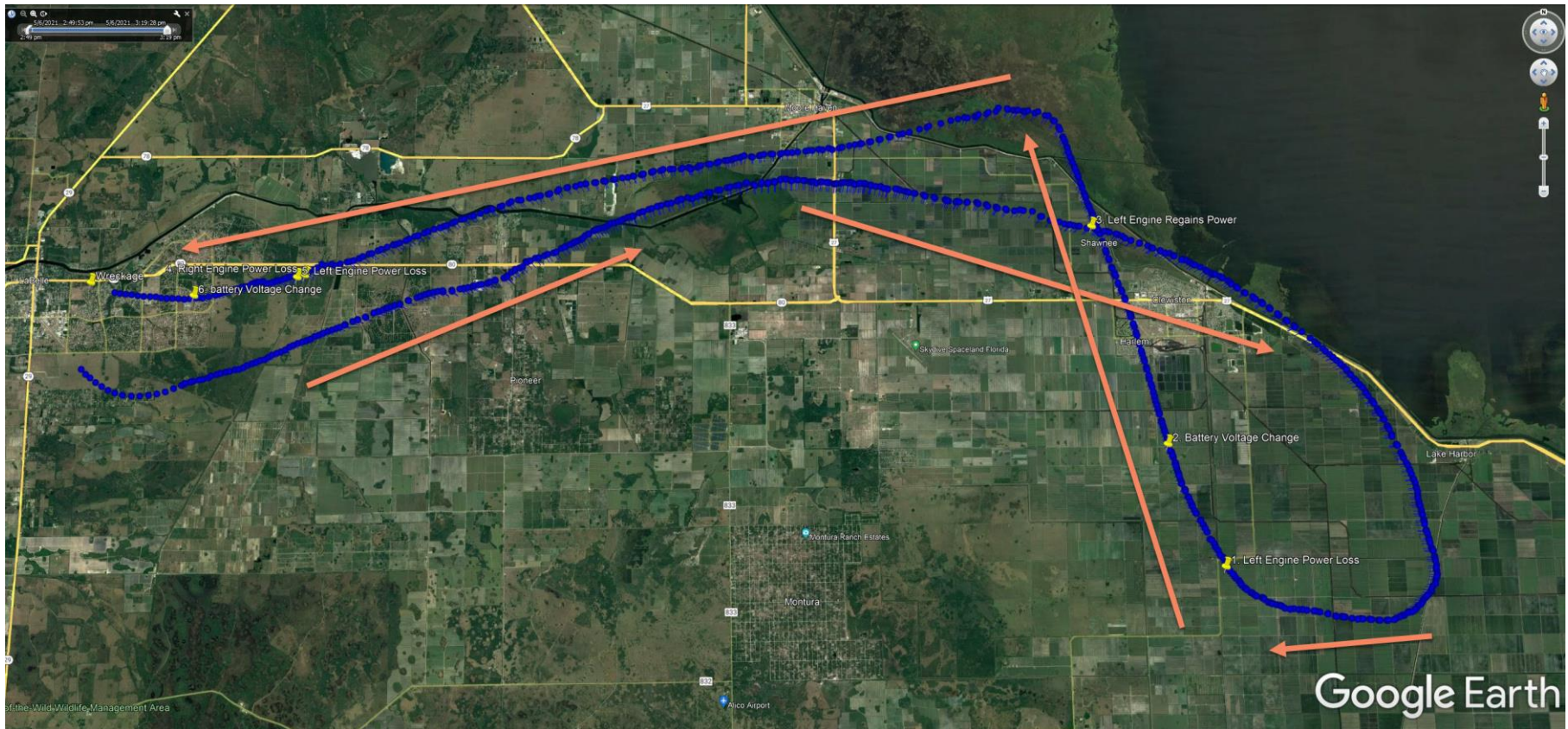


Figure 6. An overview of ADS-B data for the accident flight with locations marked from JPI engine monitor annotated.

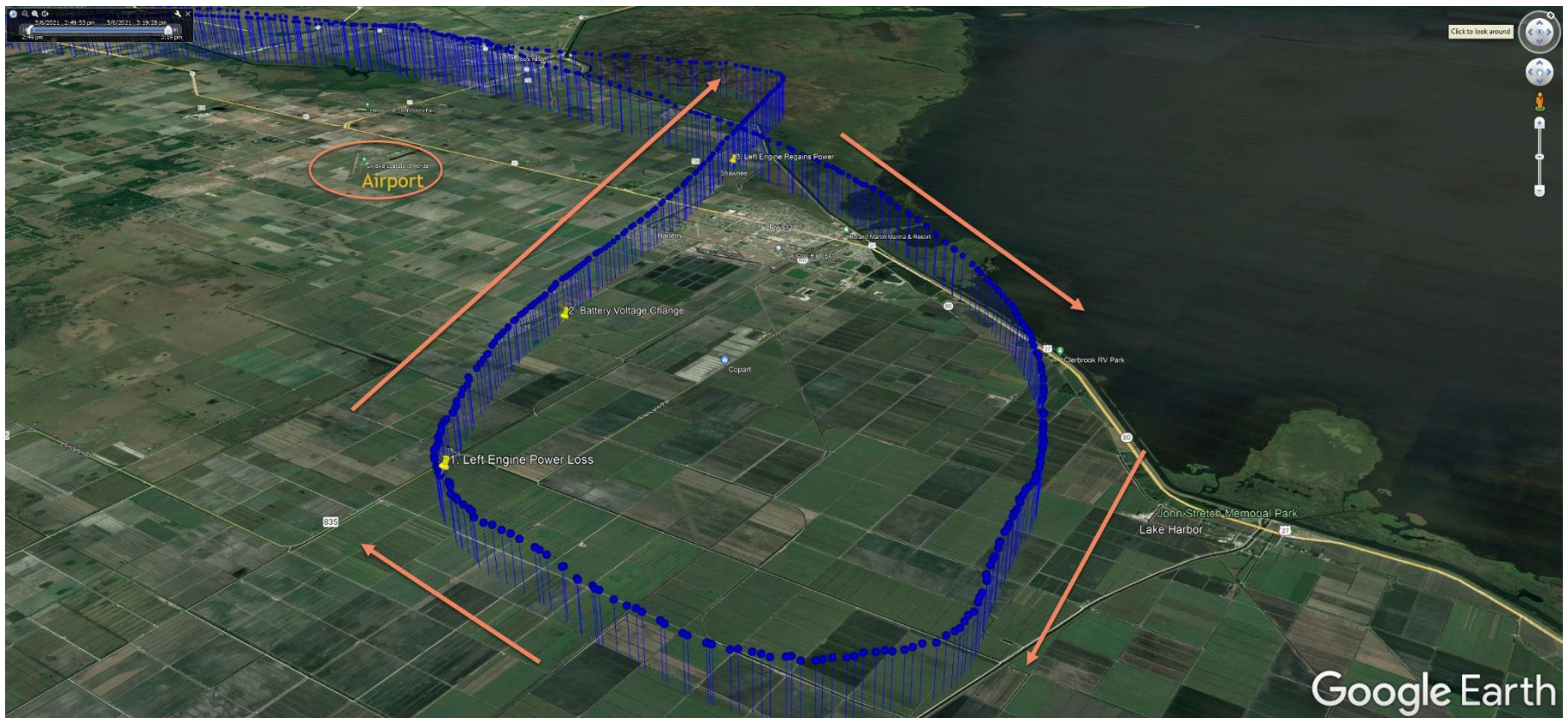


Figure 7. An overview of ADS-B data for the accident flight with locations marked from JPI engine monitor annotated. The portion illustrated is an area where the aircraft reversed course.

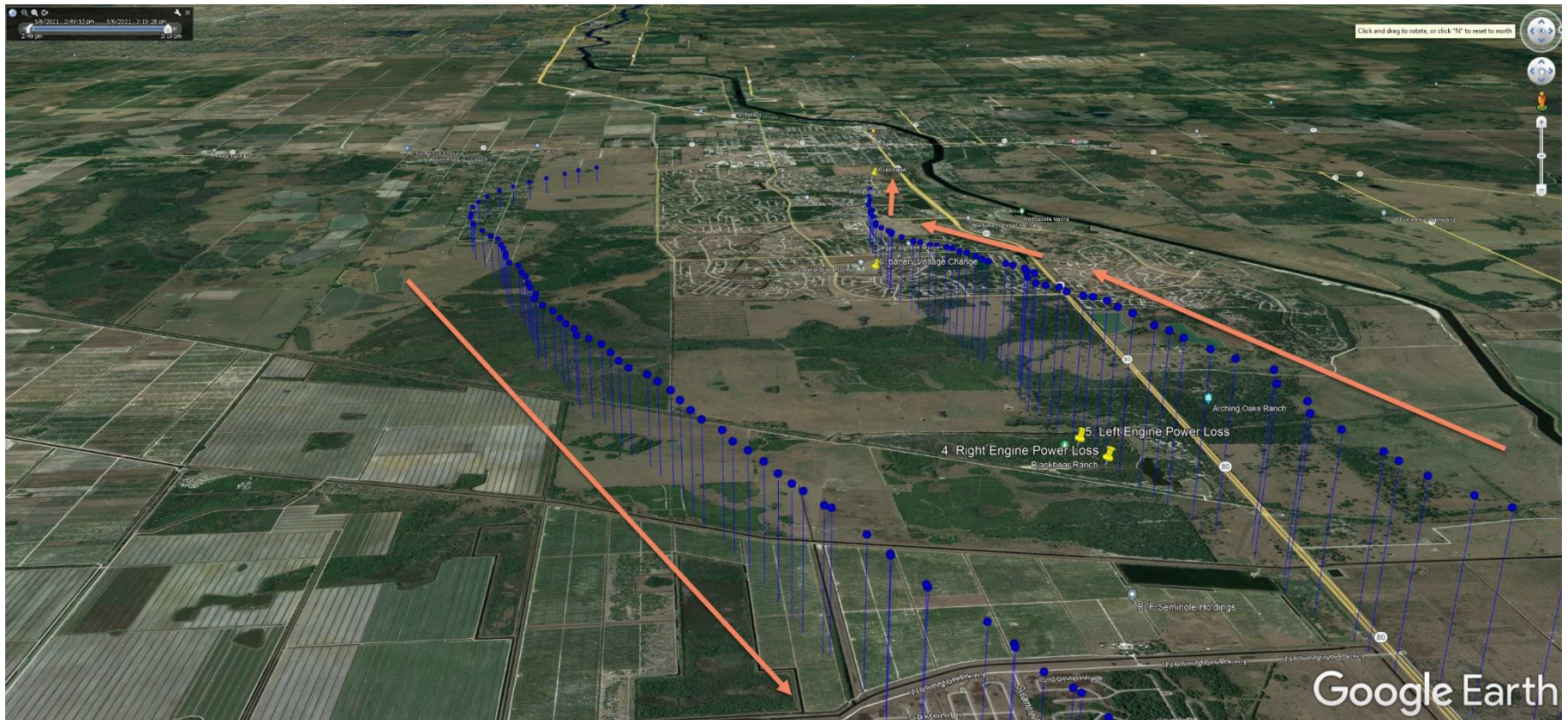


Figure 8. The final portion of the ADS-B tracklog with the wreckage location annotated.

APPENDIX A

This appendix describes the parameters provided and verified in this report. Table A-1 lists the parameters and table A-2 describes the unit abbreviations used in this report.

Table A-1. Verified and provided parameters JPI EDM-760.

Parameter Name	Parameter Description
1. Batt-1 (V)	Battery Voltage Input 1
2. Eng1 CHT-# (degF)	Left Cylinder Head Temperature Cylinder # ²
3. Eng1 EGT-# (degF)	Left Exhaust Gas Temperature Cylinder # ²
4. Eng1 Fuel Flow (gph)	Left Engine Fuel Flow
5. Eng1 Fuel Used (gal)	Left Engine Fuel Used
6. Eng1 Oil Press (psi)	Left Engine Oil Pressure
7. Eng1 Oil Temp (degF)	Left Engine Oil Temperature
8. Eng2 CHT-# (degF)	Right Cylinder Head Temperature Cylinder # ²
9. Eng2 EGT-# (degF)	Right Exhaust Gas Temperature Cylinder # ²
10. Eng2 Fuel Flow (gph)	Right Engine Fuel Flow
11. Eng2 Fuel Used (gal)	Right Engine Fuel Used
12. Eng2 Oil Temp (degF)	Right Engine Oil Temperature
13. Temp OAT (degC)	Outside Air Temperature

Table A-2. Unit abbreviations.

Units Abbreviation	Description
deg	degrees
degC	degrees Celsius
degF	Degrees Fahrenheit
gal	gallons
gph	gallons per hour
V	Volts DC

NOTE: For parameters with a unit description of discrete, 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.

² Depending on aircraft configuration number of cylinders that are instrumented varies. In the data plots the '#' is replaced with the appropriate cylinder ID.