

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

June 30, 2016

Multiple Electronic Devices

Specialist's Factual Report
By George Haralampopoulos

1. EVENT SUMMARY

Location: Colbert, Oklahoma
Date: July 26, 2015
Aircraft: Beechcraft V35B
Registration: N252G
Operator: Private
NTSB Number: CEN15FA316

On July 26, 2015, about 1500 central daylight time, a Beechcraft V35B airplane, N252G, sustained substantial damage following loss of engine power in flight and subsequent impact with the ground in Colbert, Oklahoma. The instrument rated private pilot was fatally injured and the passenger was seriously injured. The airplane was registered to Avprop, LLC and operated by a private individual under the provisions of 14 *Code of Federal Regulations* Part 91 as a personal flight. Visual meteorological conditions prevailed for the flight and an instrument flight plan had been filed. The flight originated at Jackson County-Reynolds Field (JXN), Jackson, Michigan.

2. DETAILS OF ELECTRONIC DEVICE INVESTIGATIONS

The National Transportation Safety Board's Vehicle Recorder Division received the following devices:

Recorder Manufacturer/Model: **JPI EDM-700**
Recorder Serial Number: **27773**

Recorder Manufacturer/Model: **Garmin Aera 560**
Recorder Serial Number: **1QV004151**

Recorder Manufacturer/Model: **Horizon Instruments P1000 Tachometer**
Recorder Serial Number: **0831501**

2.1. P1000 Tachometer Device and Data Description

The P1000 is a digital tachometer capable of displaying engine rotations per minute and storing tachometer time to non-volatile memory (NVM). The unit was powered on normally and a tachometer time of 3886 hours as observed (figure 1).



Figure 1. P1000 displaying tachometer time in hours.

2.2. Garmin Aera 560 Device Description

The Garmin Aera 560 is a portable GPS navigation device employing 4.3 inch touch-screen and color moving map display. The Aera is capable of storing track logs in NVM that contain GPS position information. This data is stored internally in an industry-standard format and may be transferred to a PC running Windows Explorer via USB.

Once the current track log memory becomes full, new information either overwrites the oldest information or recording stops, depending on how the unit is configured. Track log storage may be activated or de-activated at user discretion.

2.2.1. Garmin Aera 560 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior examination revealed the unit sustained impact damage to the device's touchpad and screen. An interior inspection was performed and the chip containing the device's NVM was located and extracted from the circuit board (figure 2). The data was successfully downloaded from the memory chip using forensic recovery methods.

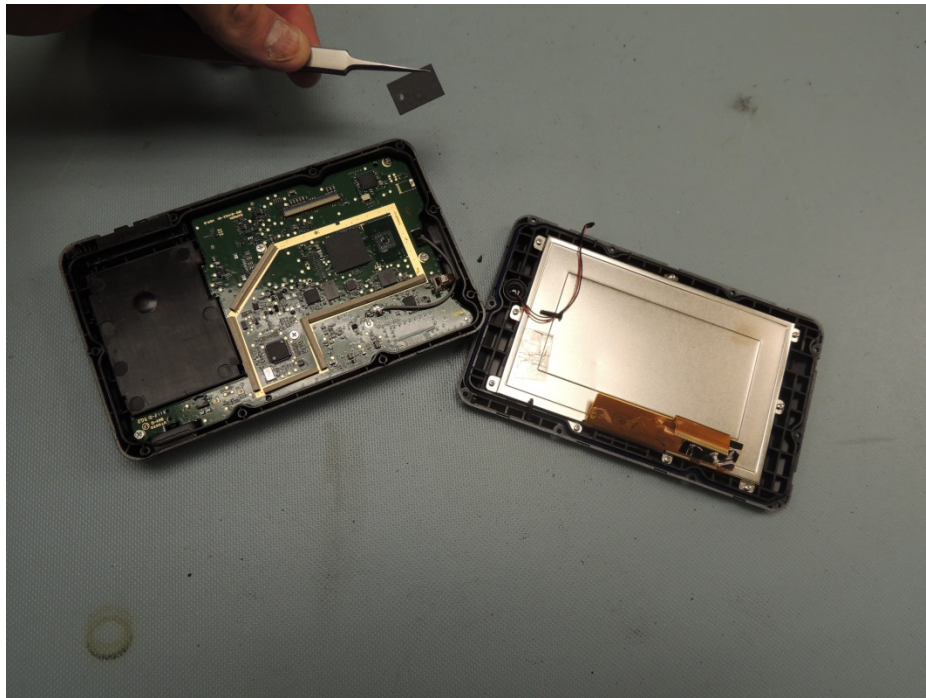


Figure 2. GPS with NVM chip removed.

2.2.2. Garmin Aera 560 Data Description

The data extracted included 37 total logs from January 22, 2014¹, through July 28, 2015. Two logs associated with the date of the event flight, July 26, 2015, were identified by the recorded date and time; the first starting at 13:09:50 UTC and ending at 17:26:02 UTC, and the second starting at 18:18:52 and ending at 20:07:47 UTC.

2.3. EDM-700 Device Description

The J. P. Instruments EDM-700 is a panel mounted gauge that the operator can monitor and record up to 24 parameters related to engine operations. Depending on the installation, engine parameters that are monitored 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

¹ The GPS records data in Coordinated Universal Time (UTC).

- 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 NVM for data storage of the parameters recorded and calculated. The data storage rate 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.

2.3.1. EDM-700 Data Recovery

Upon arrival at the Vehicle Recorder Laboratory, an exterior inspection revealed that the JPI unit had sustained visible impact damage (figure 3) and could not be powered on normally. An interior inspection of the device's circuit board revealed the memory chips containing the unit's NVM. The chips were removed and the data were successfully converted and read out using forensic methods.



Figure 3. JPI EDM-700, as received.

2.3.2. EDM-700 Data Description

The EDM recorded approximately 11,375 points of data over 11 flight logs. Two logs associated with the date of the event flight, July 26, 2015, were identified by the recorded date and time; the first starting at 13:16:02 and ending at 17:36:34, and the second starting at 18:15:48 and ending at 20:13:30. The data were observed to be sampled at once every six seconds.

2.4. EDM Data Conversions and Parameters Provided

No additional conversions were applied to the reviewed data.

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

2.5. GPS Parameters Provided

Table 1 describes data parameters provided by the GPS device. Date, Time, Latitude, Longitude, and GPS Altitude are recorded by the device. Groundspeed and Track are derived from the recorded parameters.

Table 1. GPS Data Parameters.

Parameter Name	Parameter Description
Date	Date for recorded data point (MM/DD/YYYY)
Time	Time for recorded data point (HH:MM:SS)
Latitude	Recorded Latitude (degrees)
Longitude	Recorded Longitude (degrees)
GPS Alt	Recorded GPS Altitude (feet, MSL)
Groundspeed	Derived groundspeed (knots)
Track	Derived true course (degrees)

NOTE: MSL means altitude above mean sea level.

2.6. Time Correlation

The EDM records time based on the unit's internal clock. The internal clock is set and updated by the operator and displayed upon power up. Although the recovered data appeared to be in UTC, the device could not be powered on to display the set time due to damage sustained by the device. Therefore, the data recorded by the EDM is shown as Elapsed Seconds Recorded (ESR).²

The GPS recorded time in UTC and an offset of 5 hours was subtracted to correlate to local time, CDT. The plots provided show the time in UTC; however, the attached tabular GPS data expresses both times.

3. PLOTS AND CORRESPONDING TABULAR DATA

The following figures contain EDM and GPS data recorded during the July 26, 2015 event flight. The weather and lighting conditions in Google Earth are not necessarily the weather and lighting conditions present at the time of the recording.

Figure 4 is a Google Earth overlay of all track logs recorded during the event flight. It shows the aircraft takeoff originating from Jackson County Airport (JXN), stopping over in Springfield-Branson National Airport (SGF), and then continuing a southwestern heading before the final recorded data point at 20:07:47 UTC. The first and second legs of the flight

² Time displayed on the EDM is in hours and minutes only.

recorded on the accident date are shown in red and orange, respectively. Figure 5 is an overlay that highlights the last recorded data points and data points leading up to it.

Figure 6 is a plot that contains engine parameters from the flight logs recorded during the event flight. The plot begins at 13:45:00 ESR and continues until the last recorded data point at 20:13:30 ESR. A blue divider was placed and represents a gap in engine data from 17:36:34 to 18:15:48 ESR. The gap is consistent with the time between the first and second leg shown in figure 4. Figure 7 is a plot that highlights the engine data from the last leg. A noticeable drop in EGT is shown 9 minutes before the last recorded data point at 21:13:30 ESR.

The corresponding tabular data from the GPS and EDM used to create the overlays and plots from the event flight and previous flight are provided in electronic (*.csv³) format as Attachments 1 and 2, respectively, to this report.

³ Comma Separated Value forma

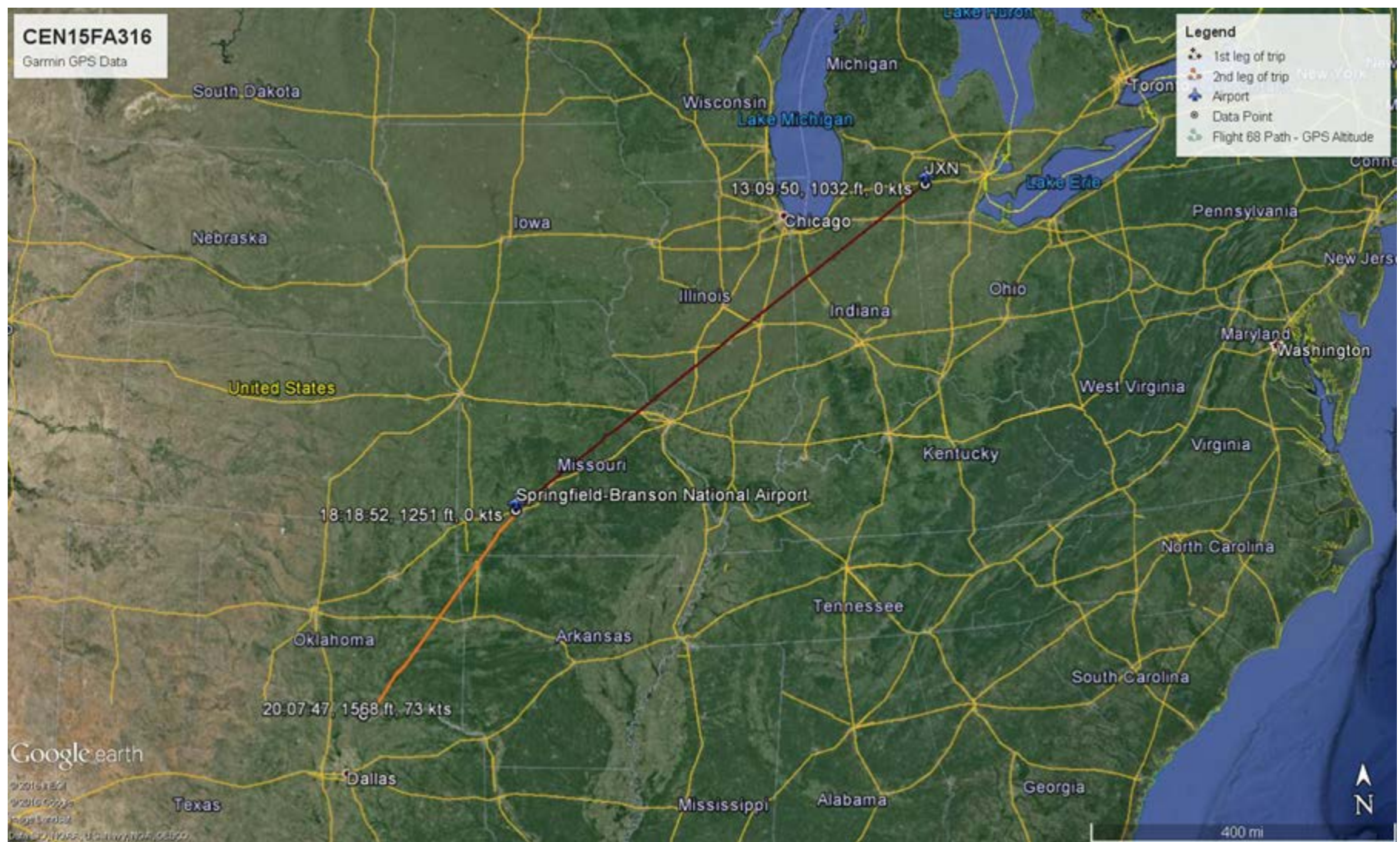


Figure 4. Overlay of all aircraft tracks recorded during event flight.

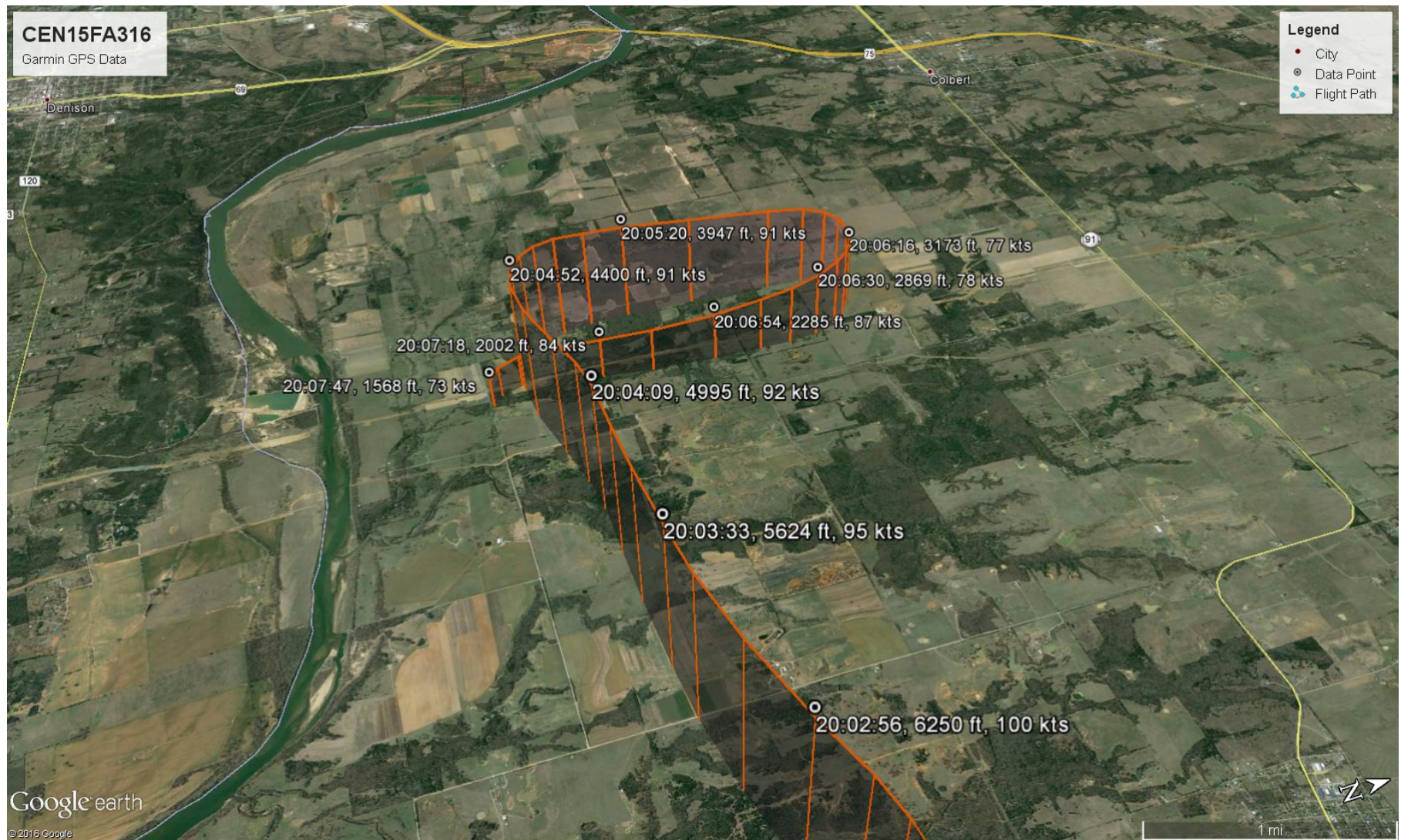


Figure 5. Overlay of aircraft track highlighting last recorded data points.

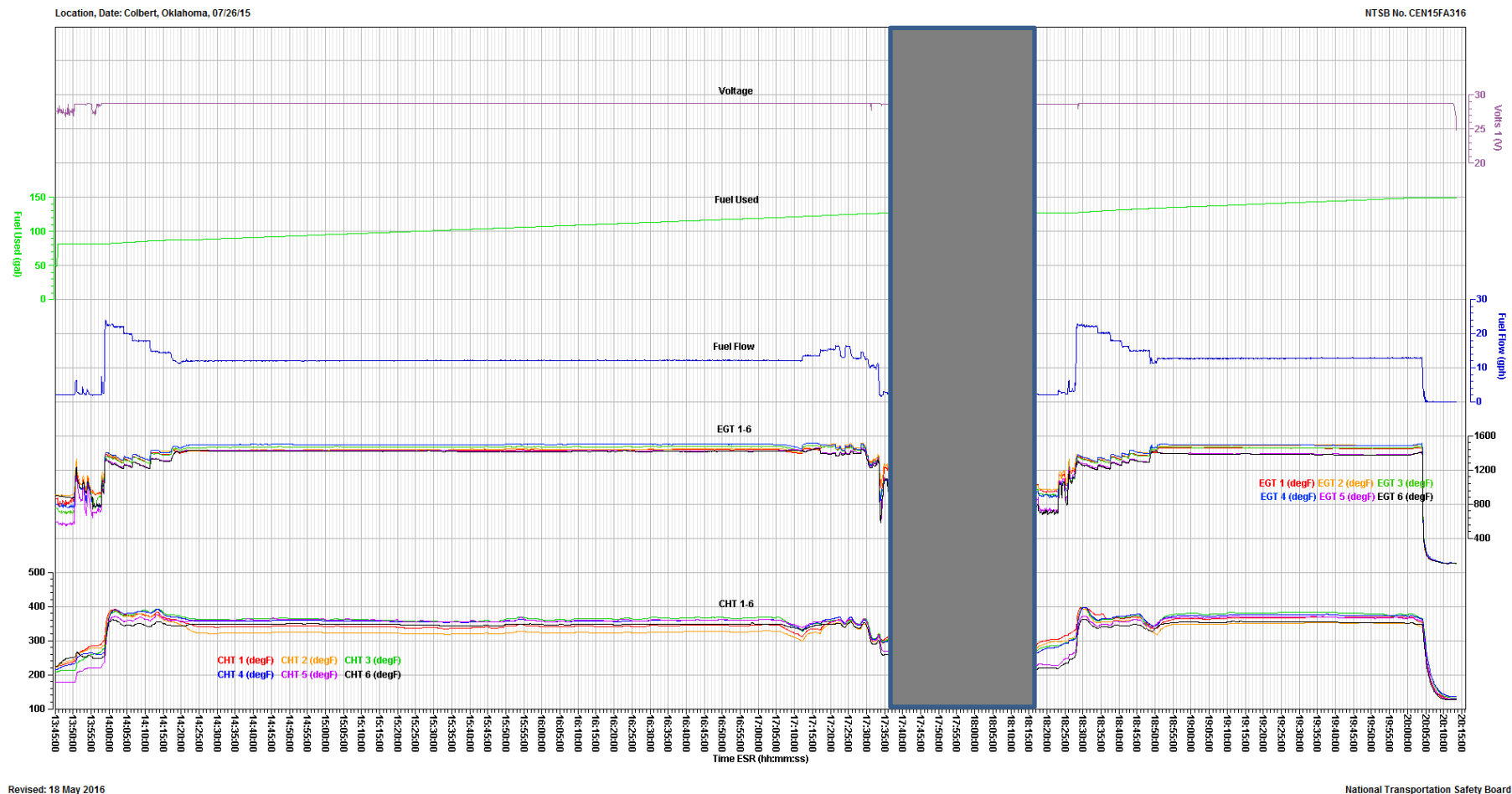
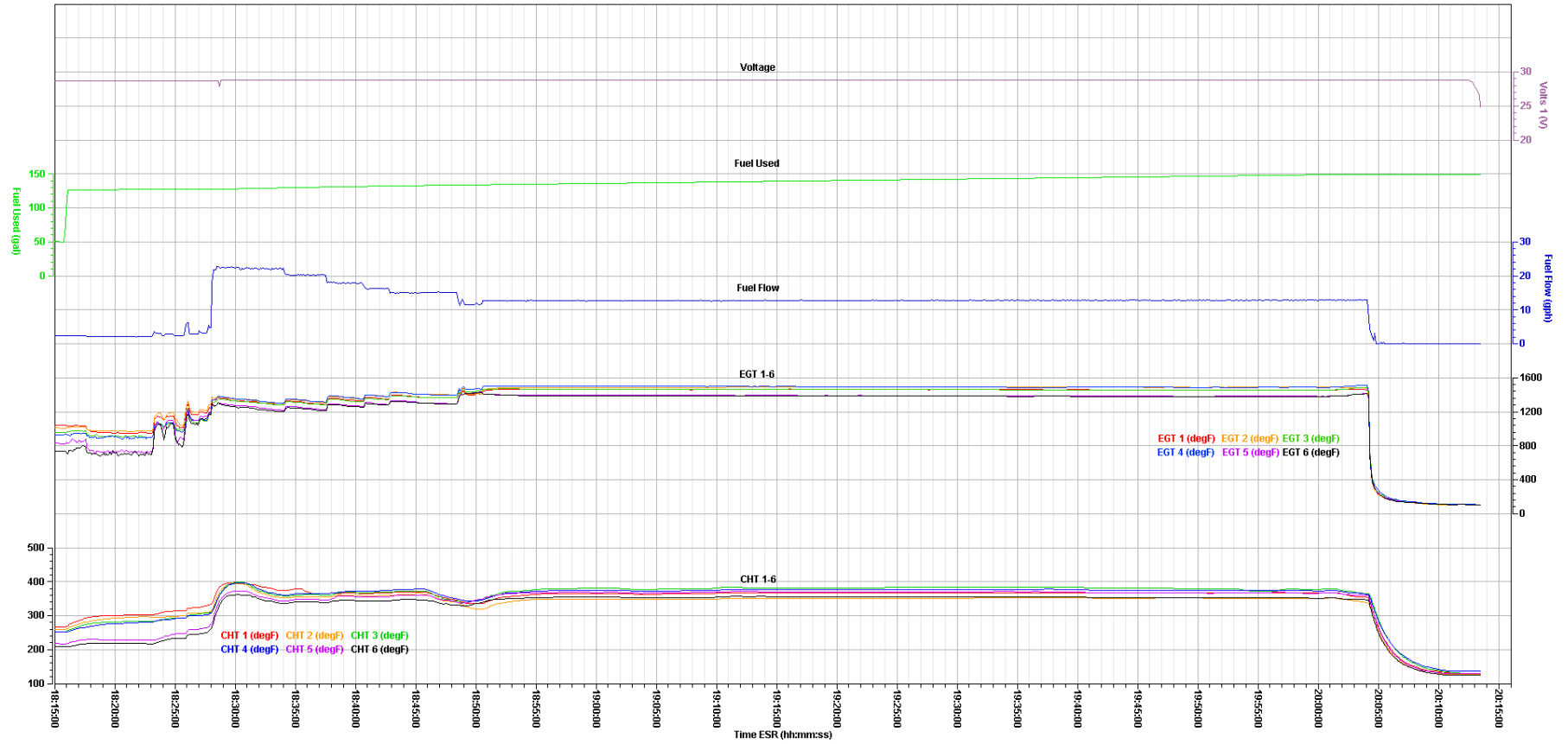


Figure 6. Plot of engine parameters from all flight logs during event flight.



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Figure 7. Plot of engine parameters during second leg.

APPENDIX A

This appendix describes the EDM 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.

Parameter Name	Parameter Description
1. CHT-# (degF)	Engine Cylinder Head Temperature Cylinder #
2. EGT-# (degF)	Engine Exhaust Gas Temperature Cylinder #
3. Fuel Used (gal)	Fuel Used
4. Fuel Flow (gph)	Fuel Flow
5. Voltage (V)	Voltage

Table A-2. Unit abbreviations.

Units Abbreviation	Description
degF	degrees fahrenheit
gal	gallons
gph	gallons per hour
V	volts