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

November 3, 2021

Engine Control Unit (ECU)

Specialist's Factual Report
By W. Deven Chen

1. EVENT SUMMARY

Location:	Darlington, Indiana
Date:	June 6, 2021
Aircraft:	Diamond DA 40 NG
Registration:	N853L
Operator:	Private
NTSB Number:	CEN21FA252

2. GROUP

A group was not convened.

3. DETAILS OF INVESTIGATION

On June 22, 2021, the National Transportation Safety Board (NTSB) Vehicle Recorder Division received the following engine control unit:

Device Manufacturer/Model:	Austro Engine 300 EECU
Serial Number:	2786

3.1. Device Description

The Austro Engine 300 EECU is the electronic engine control unit of an Austro Engine 300 (known as AE300). The EECU encloses two engine control units (ECUs), ECU A and ECU B. Each ECU contains non-volatile flash memory[1] which is used to store 16 channels of signals. These signals are sampled at an interval of 1 second as long as the ECU is powered on. Both ECUs perform this task independently. These signal channels are connected to operational data parameters including Engine Oil Pressure, Coolant Temperature, Intake Air Temperature, Battery Voltage, Power Level Position, Gearbox Oil Temperature etc. The unit can record these 16 channels at a 1 second sampling rate for about 90 hours of light time, depending on the number and duration of flights. The

[1] Non-volatile flash memory – electronic memory device that does not need external power for data retention.

oldest data will be overwritten when the memory reach full. The unit records in Coordinated Universal Time (UTC). In addition, the unit saves failure information into a non-volatile Fault Code Memory (FCM). This FCM can hold up to 20 different faults detected, including 9 environmental conditions (e.g. timestamp, voltage, temperatures, pressures, etc.) which are specific for each possible failure and are sampled and stored at the time the failure occurred. The full contents of the FCM will be included in the engine log file download.

3.2. Data Recovery

Upon arrival at the Vehicle Recorder Division, an exterior examination revealed the unit had sustained damage, as shown in Figure 1. Figure 2 shows that the main circuit board inside the unit was severely damaged, and that a processor chip was dislodged from the board. The circuit board was sent to the manufacturer in Wiener Neustadt, Austria for data recovery. The manufacturer transferred the memory chips to a surrogate EECU, and the data were downloaded with the witness of an investigator from Austrian Federal Safety Investigation Authority, Department of Civil Aviation.

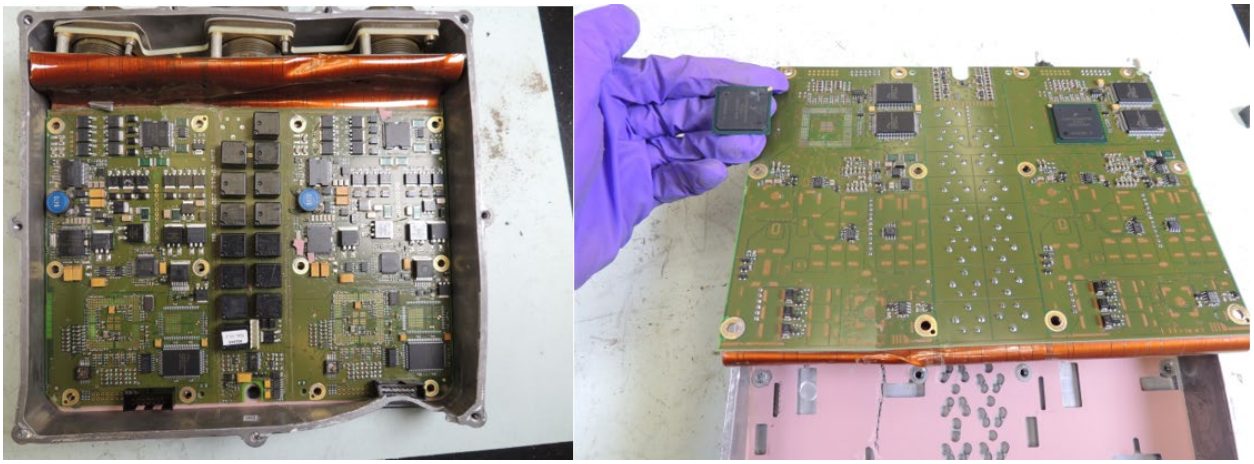


Figure 2: Main circuit board of the AE300 EECU.

3.3. Data Description

The manufacturer provided raw data, converted engineering unit data, and an inspection report that documented the data recovery process and their data analysis. The converted engineering unit data included numerous recording sessions. The manufacturer identified the last flight recording as the accident flight. The manufacturer stated that the last flight recording started at 13:36:55 and stopped 2524 seconds later at 14:18:59 UTC on June 6, 2021. The manufacturer indicated that the time stamps were from the internal Real Time Clock on the EECU, and that the Real Time Clock is rarely reset to a reference time and might show an offset of a few minutes. Only data from the accident flight recording are included in this report. All times were converted to eastern daylight time (EDT), the local time of the accident site. The different between the UTC and EDT is 4 hours.

3.4. Parameters Provided

Table 1: AE300 EECU Data Parameters.

Parameter Name	Parameter Description
Time	Eastern daylight time (EDT) for recorded data point (HH:MM:SS)
PosPL [%]	Power position level in percentage
rTrq [%]	Output torque in percentage
nProp [1min]	Engine speed in revolutions per minute (RPM)
tIntakeAir [degF]	Intake air temperature in degrees Fahrenheit
tOilEng [degF]	Engine oil temperature in degrees Fahrenheit
tOilGBX [degF]	Gearbox oil temperature in degrees Fahrenheit
tCoolant [degF]	Coolant temperature in degrees Fahrenheit
pBoost [inHg]	Boost pressure in inches of mercury
pOilEng [PSI]	Engine oil pressure in pounds per square inch
pAmbient [inHg]	Ambient air pressure in inches of mercury (measured inside the EECU enclosure)
pRail [PSI]	Common rail pressure in pounds per square inch
pFuel [PSI]	Fuel pressure in pounds per square inch
|v|OliEng [mm]	Engine oil level in milliliters (not calibrated, use only for trend analysis)
stEng [discrete]	Engine status
uBatt [V]	Battery voltage in volts

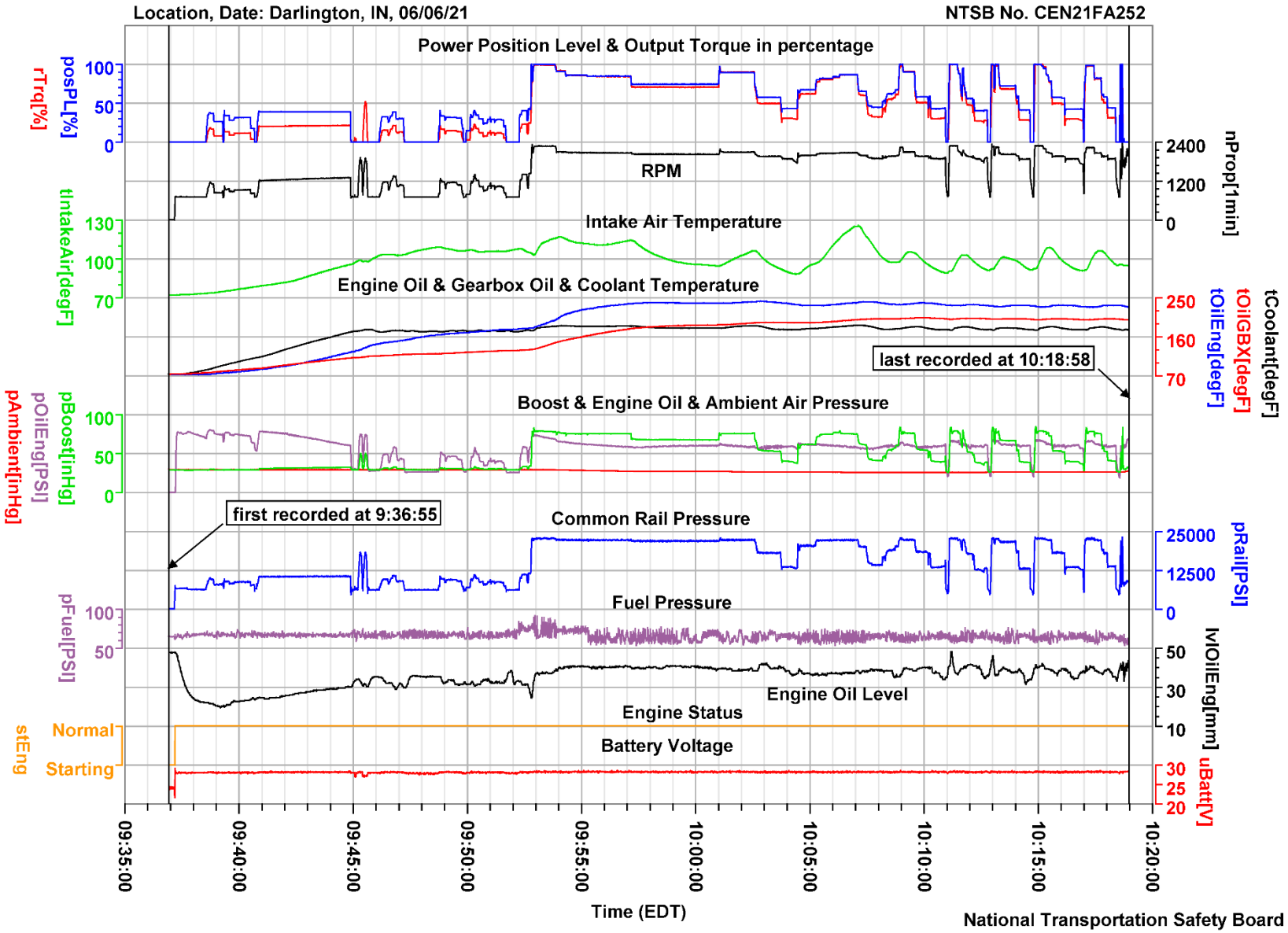
3.5. OVERLAYS AND TABULAR DATA

Figure 3 is a plot of parameters from the AE300 EECU for the entire accident flight. The time interval shown is 09:35:00 to 10:20:00 EDT on June 6, 2021.

Figure 4 is a plot of parameters from the AE300 EECU for approximately the final 4 minutes of the accident flight. The time interval shown is 10:15:00 to 10:19:00 EDT on June 6, 2021.

Figure 5 is a plot of parameters from the AE300 EECU for approximately the last minute of the accident flight. The time interval shown is 10:18:00 to 10:19:00 EDT on June 6, 2021.

The tabular data recorded by the AE300 EECU used to generate Figures 3 through 5 are provided in electronic-comma-delimited (.csv) format as Attachment 1 to this report, and the inspection report from the manufacturer is included as Attachment 2 to this report.


Location, Date: Darlington, IN, 06/06/21
NTSB No. CEN21FA252
Power Position Level & Output Torque in percentage
rTrq[%]
posPL[%]
100
50
0
RPM
nProp[1min]
2400
1200
0
Intake Air Temperature
tIntakeAir[degF]
130
100
70
Engine Oil & Gearbox Oil & Coolant Temperature
tOilEng[degF]
tOilGBX[degF]
tCoolant[degF]
250
160
70
last recorded at 10:18:58
Boost & Engine Oil & Ambient Air Pressure
pBoost[inHg]
pOilEng[PSI]
pAmbient[inHg]
100
50
0
first recorded at 9:36:55
Common Rail Pressure
pRail[PSI]
25000
12500
0
Fuel Pressure
pFuel[PSI]
100
50
Engine Oil Level
lvlOilEng[mm]
50
30
10
Engine Status
stEng
Normal
Starting
Battery Voltage
uBatt[V]
30
25
20
09:35:00
09:40:00
09:45:00
09:50:00
09:55:00
10:00:00
10:05:00
10:10:00
10:15:00
10:20:00
Time (EDT)
National Transportation Safety Board

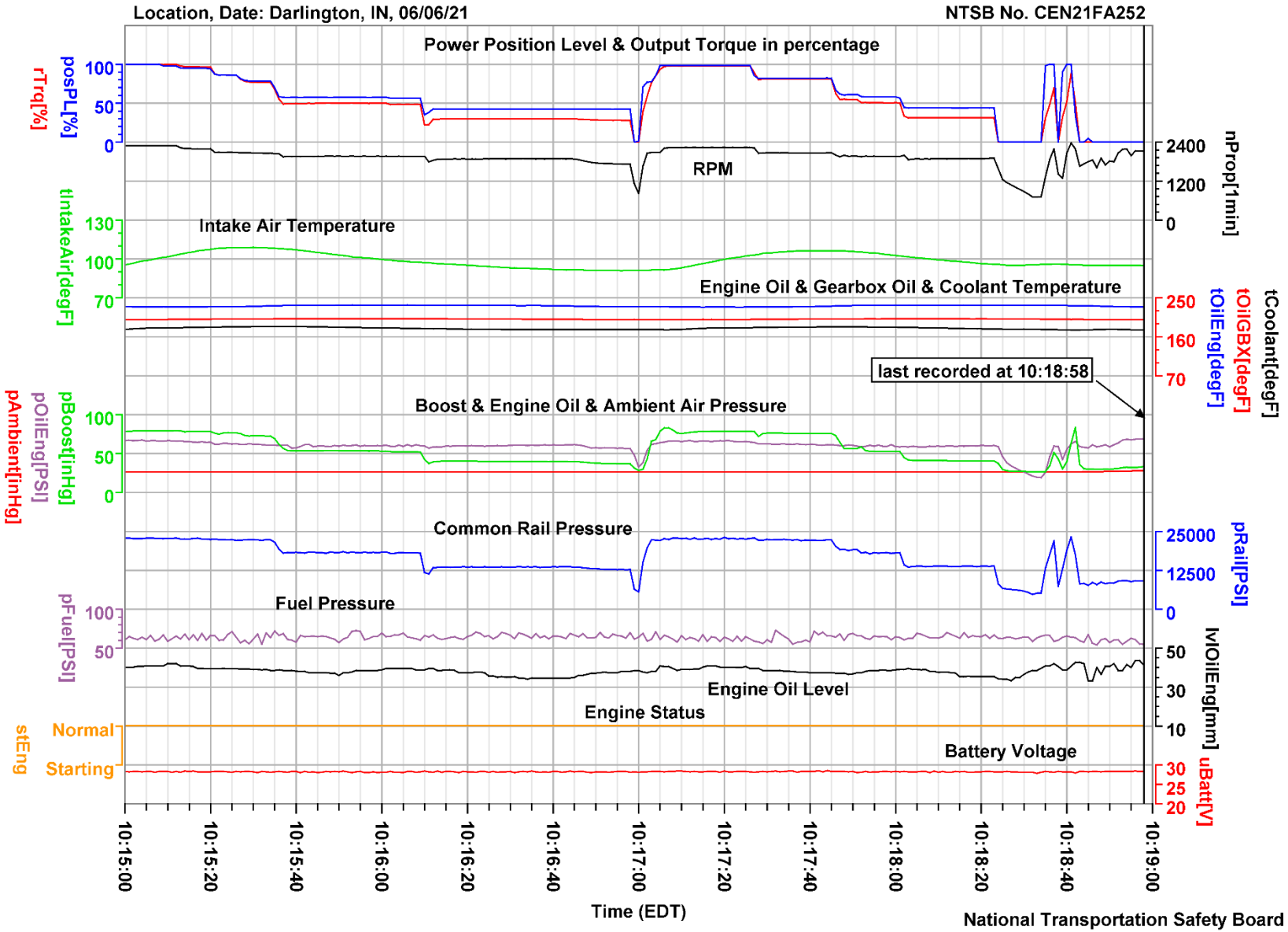


Figure 4: Plot of AE300 EECU data of approximately the last 4 minutes of the accident flight.

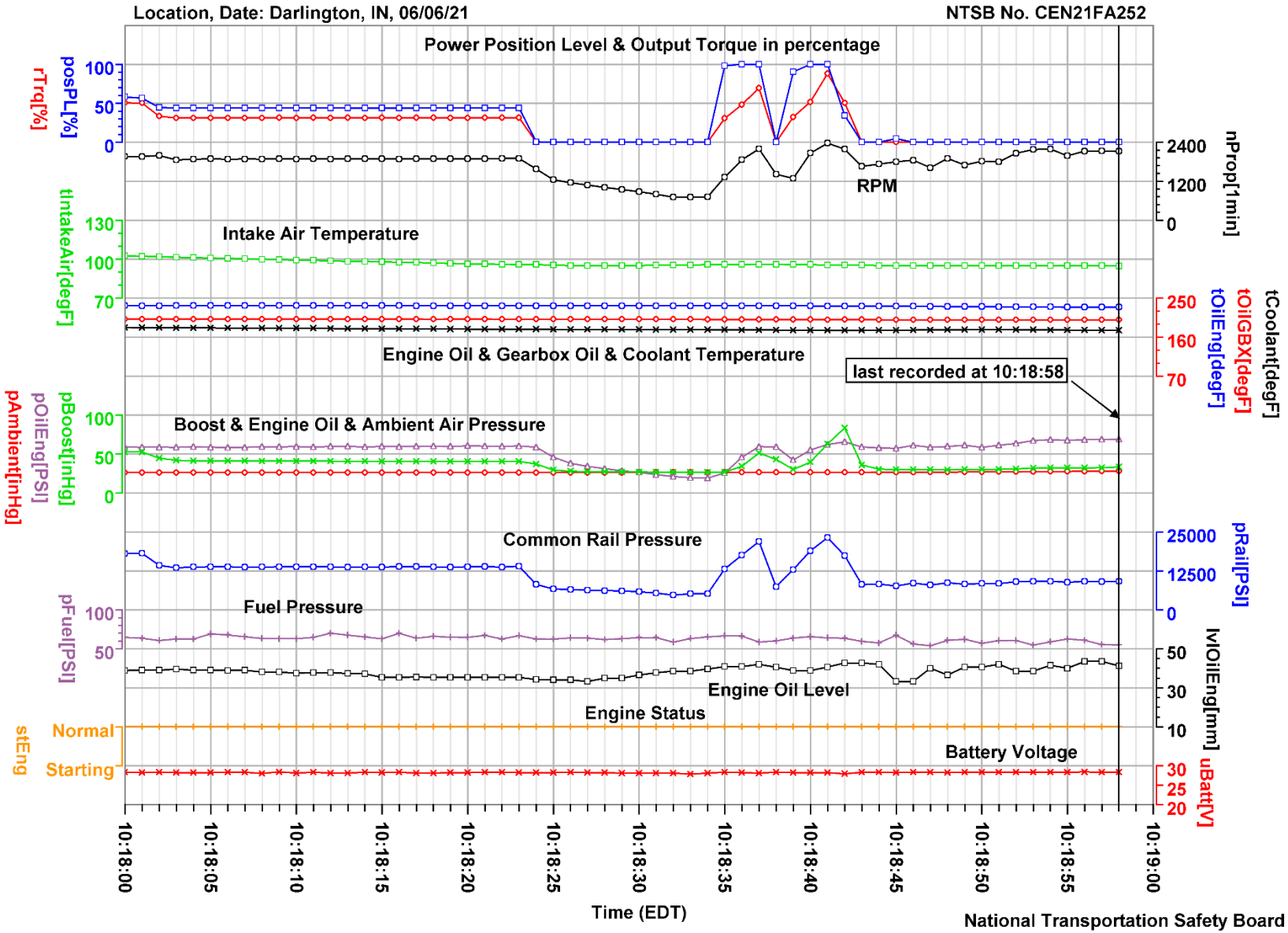


Figure 5: Plot of AE300 EECU data of approximately the last minute of the accident flight.