NATIONAL TRANSPORTATION SAFETY BOARD
Investigative Hearing

Norfolk Southern Railway general merchandise freight train 32N derailment with subsequent hazardous material release and fires, in East Palestine, Ohio, on February 3, 2023

GROUP	B
EXHIBIT	
11	

Agency / Organization

NTSB

Title

Locomotive Event Recorders Factual Report

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

RRD23MR005

LOCOMOTIVE EVENT RECORDERS

Specialist's Factual Report

May 31, 2023

A. ACCIDENT

Location: East Palestine, Ohio
Date: February 3, 2023
Time: 20:54 eastern standard time (EST)
Train: Norfolk Southern Railway 32N

B. LOCOMOTIVE EVENT RECORDERS SPECIALIST

Specialist: Cassandra Johnson
Mechanical Engineer
National Transportation Safety Board (NTSB)

C. DETAILS OF THE INVESTIGATION

A locomotive event recorder group was not convened. The NTSB Vehicle Recorder Division received event recorder files from the lead locomotive 4178 and the distributed power unit (DPU) 4412.[1]

1.0 Recording Description

Using the wheel sizes of 41.21 inches for NS 4178 and 42.65 inches for DPU 4412, the locomotive event recorder data were extracted using the Central Railway Data Playback 2020 (referred to as CDP 2020).[2] The software outputted the locomotive event recorder parameters including distance and speed. The exported data have a sampling rate of one hertz (one data sample per second); therefore, the data have an accuracy of +/- 1 second. Only data relevant to this event are provided in this report.

1.1 Parameters

Tables 1 and 2 list the locomotive event recorder parameters verified and provided in this report for NS 4178 and DPU 4412, respectively. Additionally, table 3 contains the unit and discrete state abbreviations for the parameters.

1.1.1 Speed

The resolution of speed is 1 mile per hour (mph). Thus, any movement less than 1 mph will not be shown.

[1] In this report, lead locomotive 4178 and DPU 4412 are referenced as NS 4178 and DPU 4412, respectively.
[2] The wheel sizes for both locomotives were embedded in the event recorder files.

1.2 Recorded Timing

The data was recorded in coordinated universal time (UTC). The timing was adjusted to local time, EST, by subtracting 5 hours. Therefore, the times used in this report are expressed as EST.

D. FIGURES AND TABULAR DATA

Figures 1, 3 and 5 contain locomotive event recorder data from NS 4178 recorded during the event on February 3, 2023. Additionally, figures 2 and 4 contain locomotive event recorder data from DPU 4412 recorded during the event on February 3, 2023. All the parameters listed in tables 1 and 2 are plotted except feet traveled. Figures 1 and 2 cover data from 13:30:00 EST to 00:00:00 EST, and figures 3 and 4 cover data from 20:33:00 EST to 21:00:00 EST. Figure 5 shows NS 4178's movement after the emergency from 23:00:00 EST to 00:00:00 EST with the distance traveled annotated on the plot.

The event recorder data from NS 4178 and DPU 4412 indicated at 20:54:24 EST both locomotives went into emergency when NS 4178's trainline emergency transitioned from off to emergency and DPU 4412's pneumatic control switch (PCS) transitioned from closed to open. At the time of the emergency application, NS 4178 was moving 41 miles per hour (mph) with the dynamic brake in notch 8 (DB8). Approximately 38 seconds later at 20:55:02, NS 4178 came to a complete stop and had traveled approximately 1,157 feet (ft) and DPU 4412 had traveled 1,365 ft in that time. One second later at 20:55:03 EST, DPU 4412 came to a complete stop and traveled an additional 3 ft.

At 21:27:12 EST, approximately 32.2 minutes after NS 4178 came to a complete stop, NS 4178 continued to move and traveled a total of 0.54 miles by 22:23:00 EST. About 3 minutes later at 22:25:55 EST until 23:58:46 EST, NS 4178 moved another 25.01 miles.

The corresponding tabular data used to create figures 1, 3 and 5, including feet traveled, are provided in electronic comma-separated value (CSV) format as attachment 1 to this report. Additionally, the corresponding tabular data used to create figures 2 and 4, including feet traveled, are provided in electronic CSV format as attachment 2 to this report.

Submitted by:

Cassandra Johnson
Sr. Mechanical Engineer

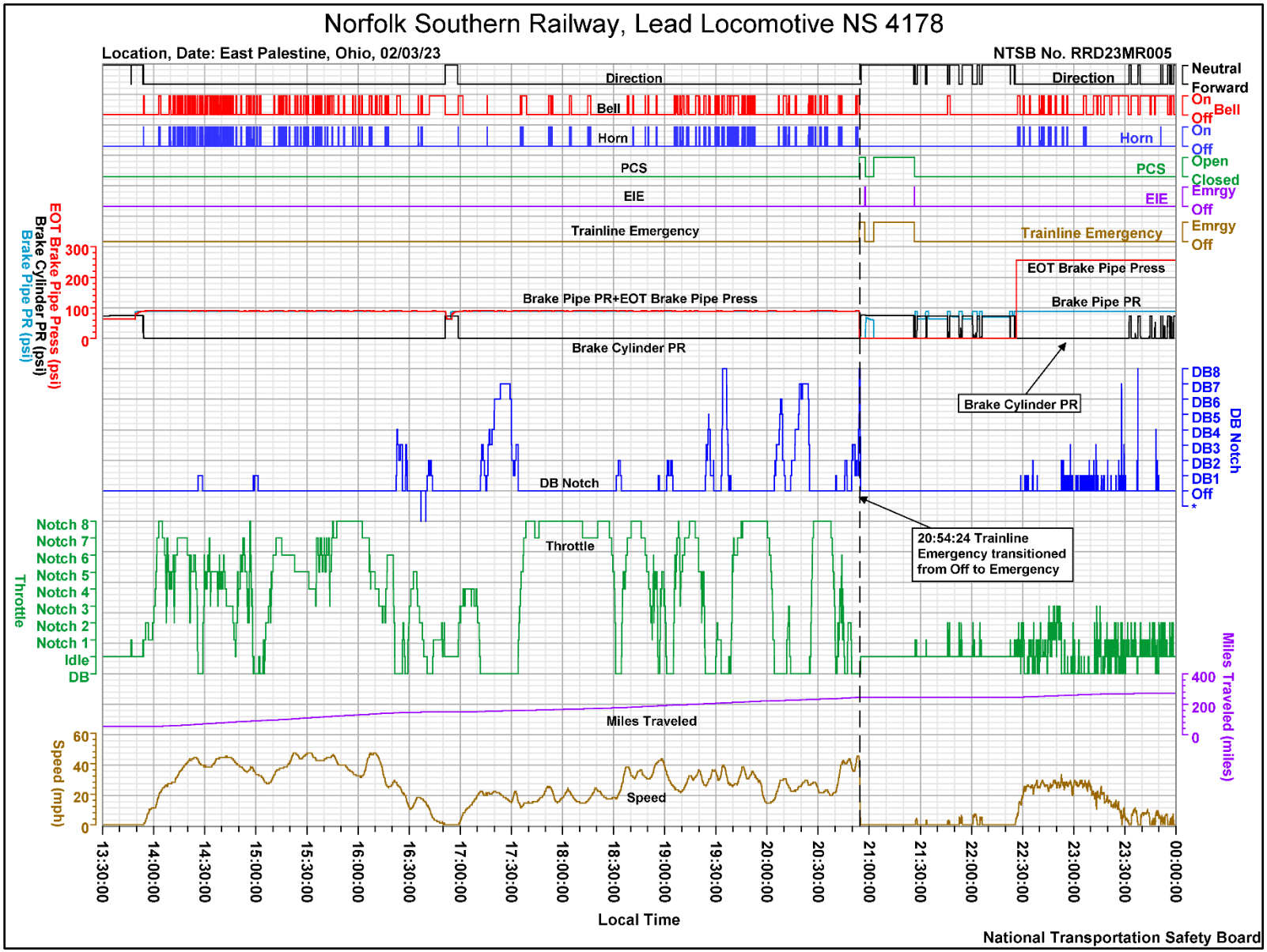

Figure 1. NS 4178's locomotive event recorder parameters from 13:30:00 EST to 00:00:00 EST.

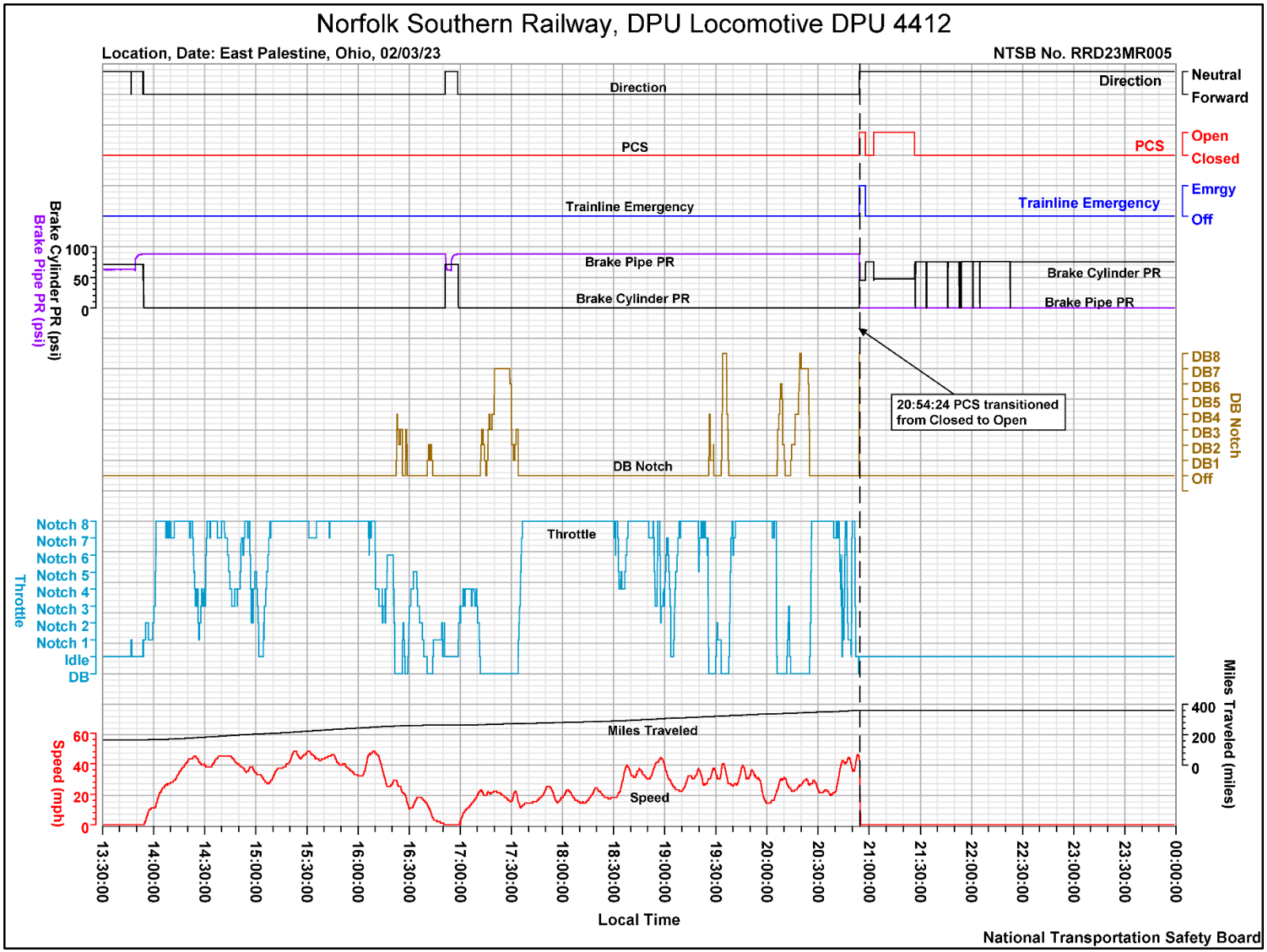

Figure 2. DPU 4412's locomotive event recorder parameters from 13:30:00 EST to 00:00:00 EST.

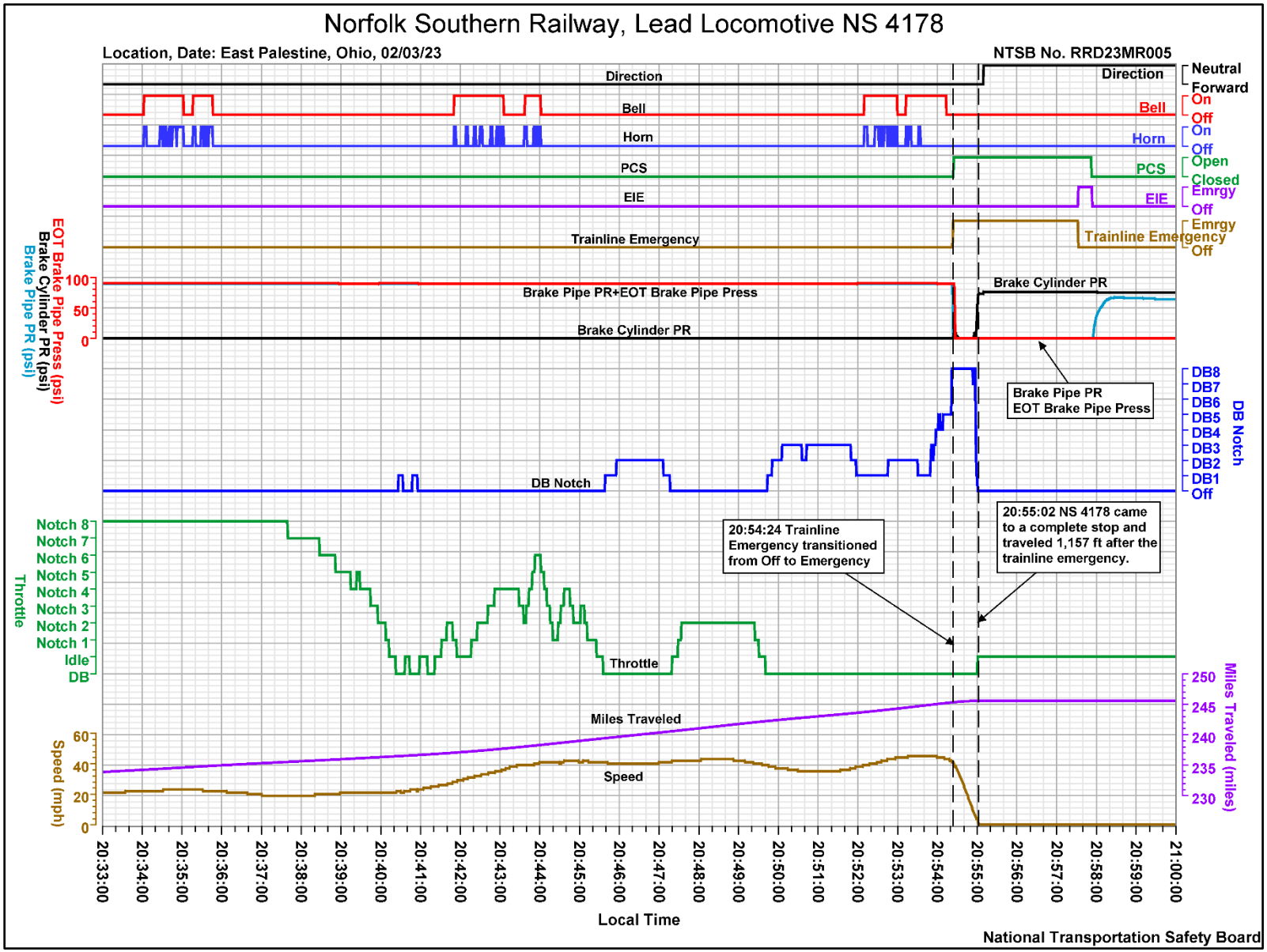

Figure 3. NS 4178's locomotive event recorder parameters from 20:33:00 EST to 21:00:00 EST.

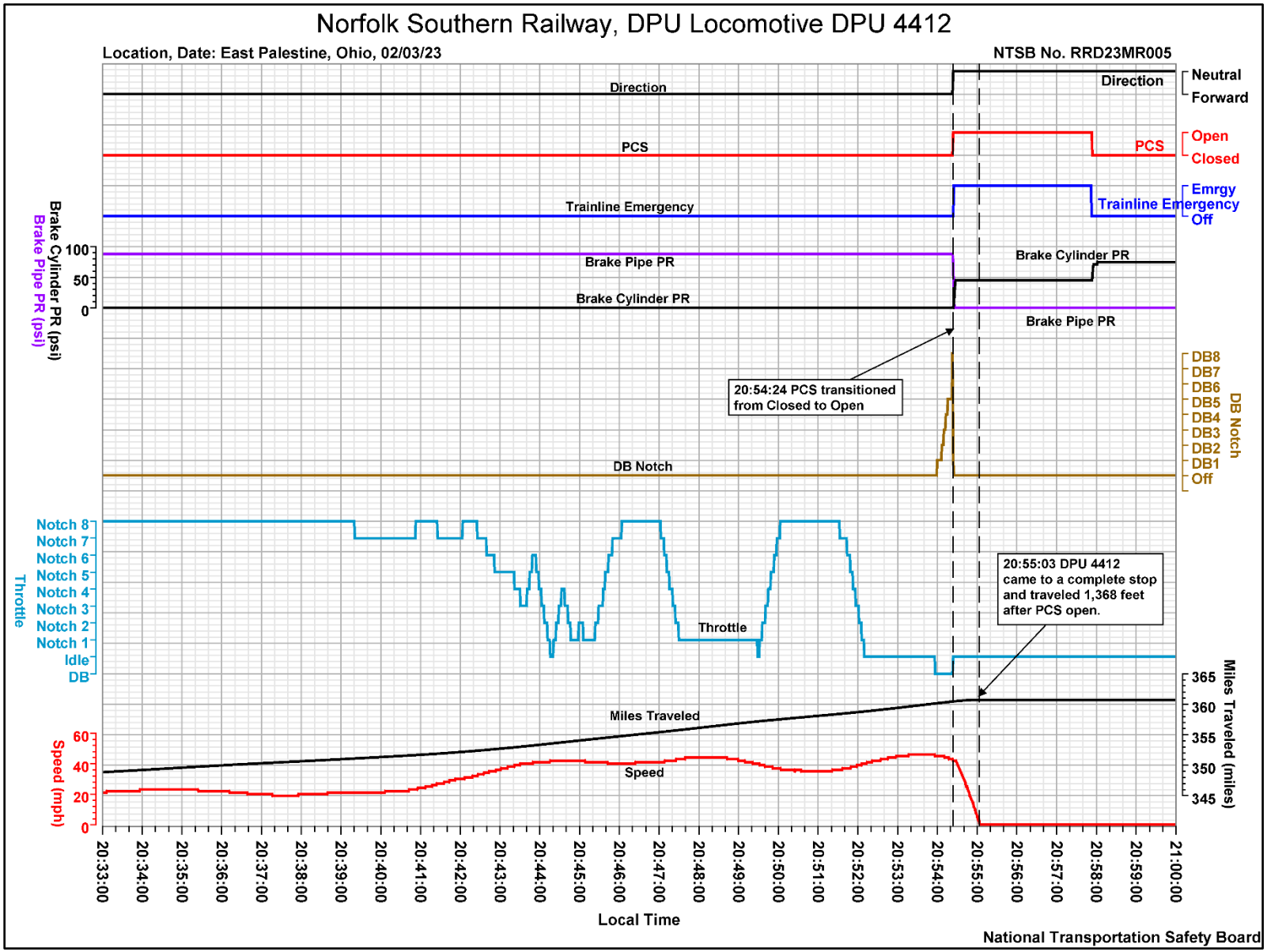

Figure 4. DPU 4412's locomotive event recorder parameters from 20:33:00 EST to 21:00:00 EST.

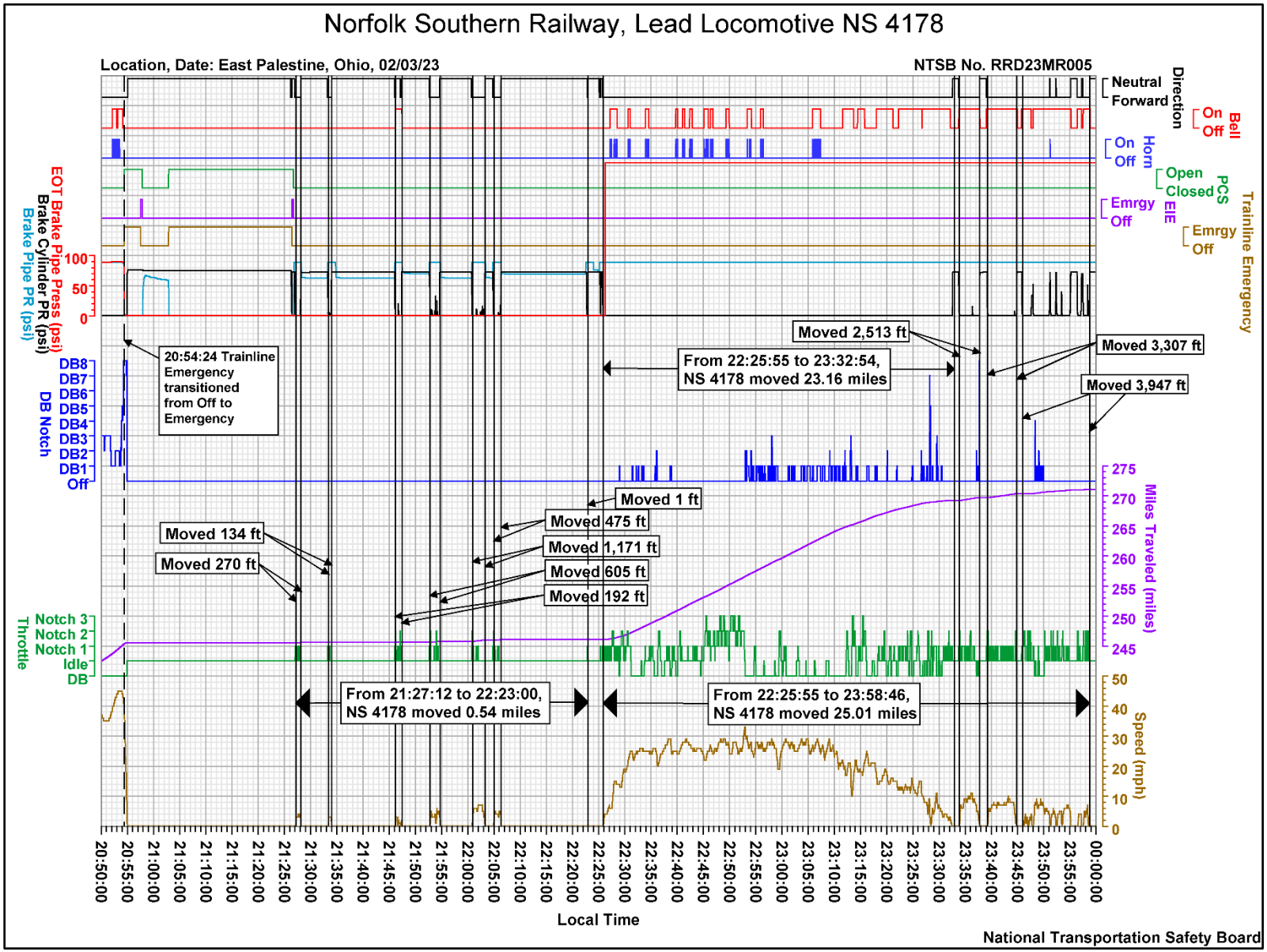

Figure 5. NS 4178's locomotive event recorder parameters from 20:50:00 EST to 00:00:00 EST with annotated distances traveled.

APPENDIX A. VERIFIED AND PROVIDED PARAMETERS

This appendix describes the locomotive event recorder parameters provided and verified in this report for NS 4178 and DPU 4412. Tables 1 and 2 list the parameters, parameter descriptions, and units for NS 4178 and DPU 4412, respectively. In tables 1 and 2, parameters with a blank unit description are discretes. 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. Table 3 contains the unit and discrete state abbreviations for the parameters.

Table 1. Verified and provided locomotive event recorder parameters for NS 4178.

Parameter	Parameter Description	Unit
Bell	Bell	
Brake Cylinder PR	Brake Cylinder Pressure	psi
Brake Pipe PR	Brake Pipe Pressure	psi
DB Notch	Dynamic Brake Notch Position	
Direction	Direction of Travel	
EIE	Engineer Initiated Emergency	
EOT Brake Pipe Press	End of Train Brake Pipe Pressure	psi
Feet Traveled	Feet Traveled	ft
Horn	Horn	
Miles Traveled	Miles Traveled	miles
PCS	Pneumatic Control Switch	
Speed	Speed	mph
Throttle	Throttle Position	
Trainline Emergency	Trainline Emergency	

Table 2. Verified and provided locomotive event recorder parameters for DPU 4412.

Parameter	Parameter Description	Unit
Brake Cylinder PR	Brake Cylinder Pressure	psi
Brake Pipe PR	Brake Pipe Pressure	psi
DB Notch	Dynamic Brake Notch	
Direction	Direction of Travel	
Feet Traveled	Feet Traveled	ft
Miles Traveled	Miles Traveled	miles
PCS	Pneumatic Control Switch	
Speed	Speed	mph
Throttle	Throttle Position	
Trainline Emergency	Trainline Emergency	

Table 3. Unit and discrete state abbreviations.

Unit and Discrete State Abbreviation	Description
DB	Dynamic Brake
DB1	Dynamic Brake Position 1
DB2	Dynamic Brake Position 2
DB3	Dynamic Brake Position 3
DB4	Dynamic Brake Position 4
DB5	Dynamic Brake Position 5
DB6	Dynamic Brake Position 6
DB7	Dynamic Brake Position 7
DB8	Dynamic Brake Position 8
Emrgy	Emergency
ft	feet
mph	miles per hour
psi	pounds per square inch