

National Transportation Safety Board
Office of Railroad, Pipeline and Hazardous Materials Investigations
Washington, D.C. 20594

Smoke and Arcing at L'Enfant Plaza Subway Station

Washington D.C.

January 12, 2015

Mechanical Group Factual Report

Addendum 1

(The purpose of this addendum is to factually determine the movements of the master controller (throttle) of train 302 during the incident)

Accident

NTSB Accident Number: DCA15FR004
Date of Accident: January 12, 2015
Time of Accident: 3:15 p.m. (EST¹)
Type of Trains: WMATA Transit Railcars
Railroad Owner: WMATA
Train Operator: WMATA
Fatalities: 1
Number of passengers
that visited local hospitals 86
Location of Accident: L'Enfant Plaza, Washington D.C.

Mechanical Group Members

National Transportation Safety Board
Group Chairman
Michael Hiller

National Transportation Safety Board
Joey Rhine

Federal Transit Administration
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Washington Metropolitan Transit Authority
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Washington Metropolitan Transit Authority
Sachit Kakkar

¹ Eastern standard time

Accident Synopsis

On Monday, January 12, 2015, about 3:15 p.m. eastern standard time, Washington Metropolitan Area Transit Authority (WMATA) Metrorail train 302 stopped after encountering an accumulation of heavy smoke while traveling southbound in a tunnel between the L'Enfant Plaza Station and the Potomac River Bridge in the District of Columbia.

About 400 passengers were on board the six-car passenger train at the time of the accident. Some passengers self-evacuated from train 302, while others were assisted by emergency responders. The smoke originated from an arcing event near the third rail about 2,000 feet south of the L'Enfant Plaza Station. Smoke filled the L'Enfant Plaza Station causing an evacuation of the station. District of Columbia Fire and Emergency Management Services reported that 86 people were treated and transported from the scene, another 9 passengers self-transported to medical facilities. There was one passenger fatality.

A following train (train 510), stopped at the L'Enfant Plaza Station at about 3:25 p.m., and was also affected by the heavy smoke. This train stopped about 100 feet short of the south end of the platform. Passengers of both trains, as well as passengers on the station platforms, were exposed to the heavy smoke. Train 510 was evacuated while it was stopped at the station platform, where arriving WMATA Transit police officers, Metrorail/L'Enfant Plaza Station Managers and WMATA Supervisor personnel provided assistance in guiding passengers to the surface. Some passengers aboard Train 302 began to self-evacuate as it remained in the tunnel. Emergency responders were dispatched to the scene and an evacuation of the train and station area ensued.

Both Metrorail trains involved in this incident consisted of six passenger railcars and were about 450 feet in length. As a result of the smoke, 86 passengers were transported to local medical facilities for treatment. There was one passenger fatality. Initial damages were estimated by WMATA at \$120,000.00.

Atmospheric conditions at the time of the incident were reported as rain/mist, calm winds and 37°F. (Weather reported from Reagan National Airport, about 1 mile south of the tunnel portal near the Potomac River Bridge).

The parties to this investigation are Washington Metropolitan Transit Authority, the Federal Transit Administration, the Tri-State Oversight Committee, the Amalgamated Transit Union 689, the International Fire Fighters Association 36, the District of Columbia Fire and Emergency Medical Services, the Metropolitan Police Department, and the Bureau of Alcohol, Tobacco, Firearms and Explosives.

Train Consist 302

Southbound WMATA train 302 consisted of six railcars mechanically, electrically and pneumatically joined together. Each railcar weighs about 80,000 lbs. and is 75 feet in length. The total estimated weight of an empty train is about 480,000 lbs. and the total estimated length is about 450 feet.

The railcars in train 302 are designated as follows:

1. 6134 – lead railcar
2. 6135
3. 1285
4. 1284
5. 3030
6. 3031 – trailing railcar

All Metrorail revenue railcars operate in married pairs with an operating cab at each end.² Each pair of railcars is electrically powered and fully automated. The railcars are equipped with a friction brake system, a low voltage system, automatic heating ventilation and air conditioning control and automatic couplers.³ The railcars must operate in married pairs; no railcar can be operated as a single unit. Primary propulsion power is supplied by a 750 volt direct current (VDC) third rail system.

Accident Sequence

Railcars 6134, 6135, 3030 and 3031 were all equipped with onboard event recorders. The recorders continuously record several parametric parameters such as speed and braking when the train is being operated. The data was successfully downloaded, analyzed and plotted by NTSB's Recorder division and provided to the mechanical group.⁴ The data was reviewed along with the data from the train propulsion power system, or sub stations, which is monitored using a supervisory control and data acquisition system (SCADA) that maintains a record of the status of the system.⁵ The SCADA log records changes in parameters such as circuit breaker condition for the track at the L'Enfant Plaza station. Investigators also interviewed the operator of train 302.

The master controller position (MCP) is not a direct input into WMATA's event recorder system. The MCP must be derived from a number of discrete signals recorded by the event recorder. Using the WMATA provided matrix for decoding MCP, the NTSB developed a decoding scheme to interpret MCP. See attachment 1. All of

² The WMATA 7000 series is designed with only one operating cab per married pair. The minimum operating consist is 4-cars.

³ This list is not all inclusive.

⁴ More information is available in the On-Board Data Recorders Group Chairman's Factual Report.

⁵ More information is available in the Railroad Signal & Train Control, Traction Power And Track Group factual report.

the corresponding tabular data used to create the figures and the plots along with the 13 parameters needed to decode MCP are provided in electronic (.csv) format as separate attachment 2 to this report.

For this report, NTSB's recorder division utilized the data downloaded from train 302's event recorders to determine the position of the master controller, or throttle, after the operator reversed ends. Understanding the position on the master controller will allow investigators to understand if and when the operator of train 302 attempted to move. For more information refer to the *Mechanical Group Factual Report*, located in NTSB's docket (DCA15FR004).

As discussed in the *Mechanical Group Factual Report*, event recorder data showed train 302 departing L'Enfant Plaza on track 2 moving south at 3:14:25 p.m. The train's speed increased to about 17 MPH and then slowed to 15 MPH. After traveling 182 feet, the battery voltage on the leading pair of railcars, 6135 and 6134, began to drop from a normal voltage of 37 VDC. At 3:14:42 p.m., 17-seconds after departing L'Enfant plaza, the battery voltage dropped to 32 VDC. As the train continued south, the trailing railcars battery voltage, 3030 and 3031, also dropped to about 32 volts. Event recorder data indicated train 302 came to a stop at 3:15:15 p.m. after traveling a distance of about 800 feet.

The operator of train 302 stated he observed heavy smoke after departing the L'Enfant Plaza station, stopped his train and notified the operations control center (OCC) that he was going to reverse ends in preparation to return to the platform.⁶ Event recorder data shows the MCP in the lead railcar, 6134, in position B5, (braking mode 5) at 3:15:15 p.m., as the train came to a stop. For the next 7-seconds, the MCP in car 6134 changed rapidly from B5. Figure 1 shows the successive changes and time duration associated with the MCP. MCP is represented as the purple line in figures 1 through 5. The plot shows the MCP moved to a power mode, P2 (power mode 2) at 3:15:20 p.m. The MCP was in this position for less than 1-second. Again, the plot shows that the MCP moved to P1 (power mode 1) at 3:15:22 p.m. The MCP was in this position for less than 1-second. At 3:15:22 p.m., event recorder data shows the MCP is returned to B5.

⁶ Reversing ends is an operational term meaning train operator will physically move to the trailing railcar, activate the console and be prepared to move in the opposite direction.

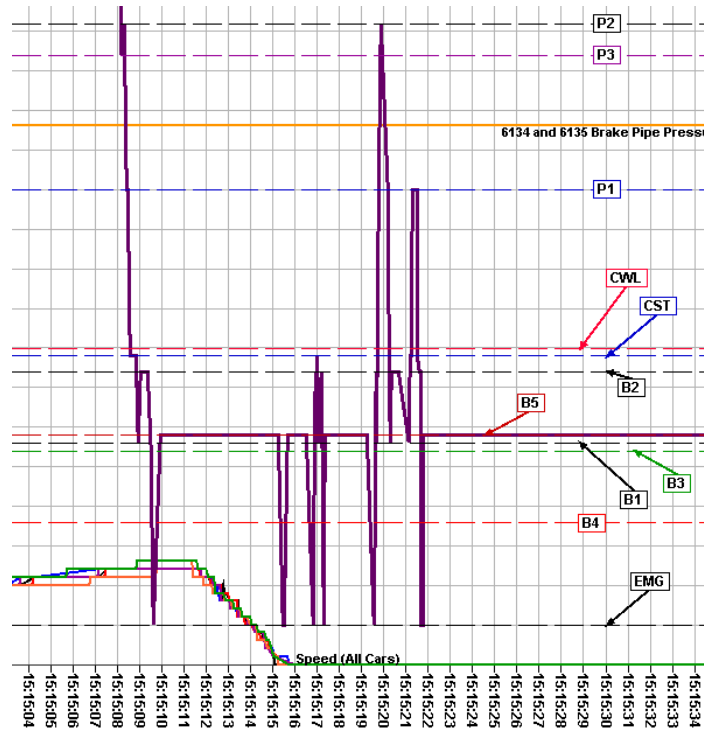


Figure 1-Event recorder plot showing MCP of train 302

The lead car of train 302, 6134, was stationary in a keyed up condition, with the MCP in B5 until the car was keyed down at, 3:16:34 p.m. At 3:18:45 p.m., event recorder data shows the trailing railcar, 3031, was keyed up, indicating the train was now powered from the trailing end. Upon key up, the MCP is in EMG and at 3:18:48 p.m., is moved to B5. Event recorder data shows the MCP is moved to P5 (power mode 5) for less than 1-second and is moved to B5. At 3:18:54 p.m., the MCP moves to P5 and subsequently transitions to P4. The MCP was then moved to B5 at 3:18:56 p.m. See figure 2.

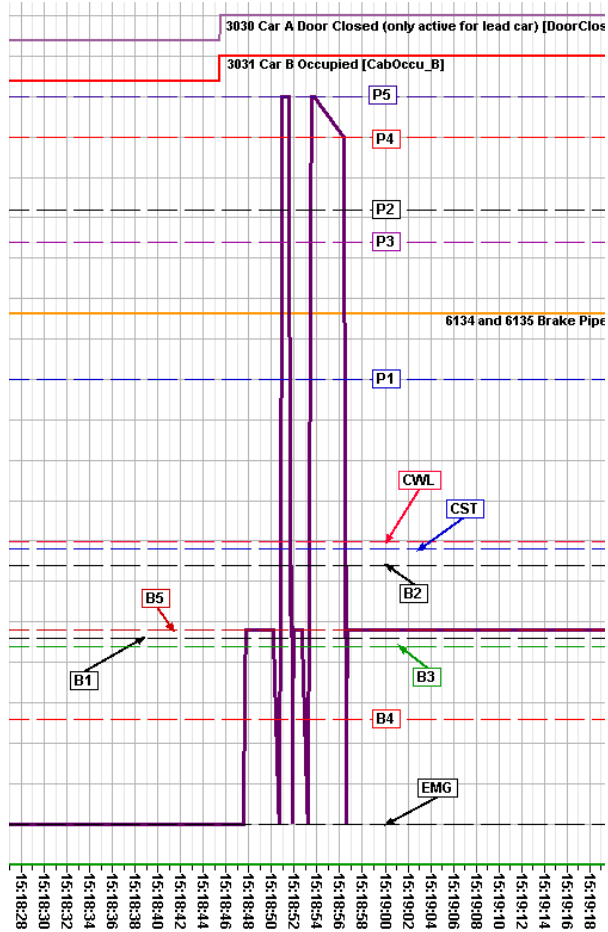


Figure 2- Event recorder plot showing MCP of train 302

At 3:21:30 p.m., the MCP momentarily changes state from B5 to EMG. See figure 3. This change is accompanied by a momentary status change (from 1 to 0 back to 1) of the ‘Car A door closed’ signal. Event recorder data shows at 3:22:36 p.m., the MCP moves from B5 to P5 (power mode 5) for 6-seconds. The train speed signal (circled in blue on figure 3) momentarily changes from 0 mph to 2 mph and returns to 0 mph. Beginning at 3:22:42 p.m., the MPC is moved from B5 to P5 five times, no changes in the train’s speed signal are observed in the data. At 3:25:18 p.m., the MCP is moved to the B5 position.

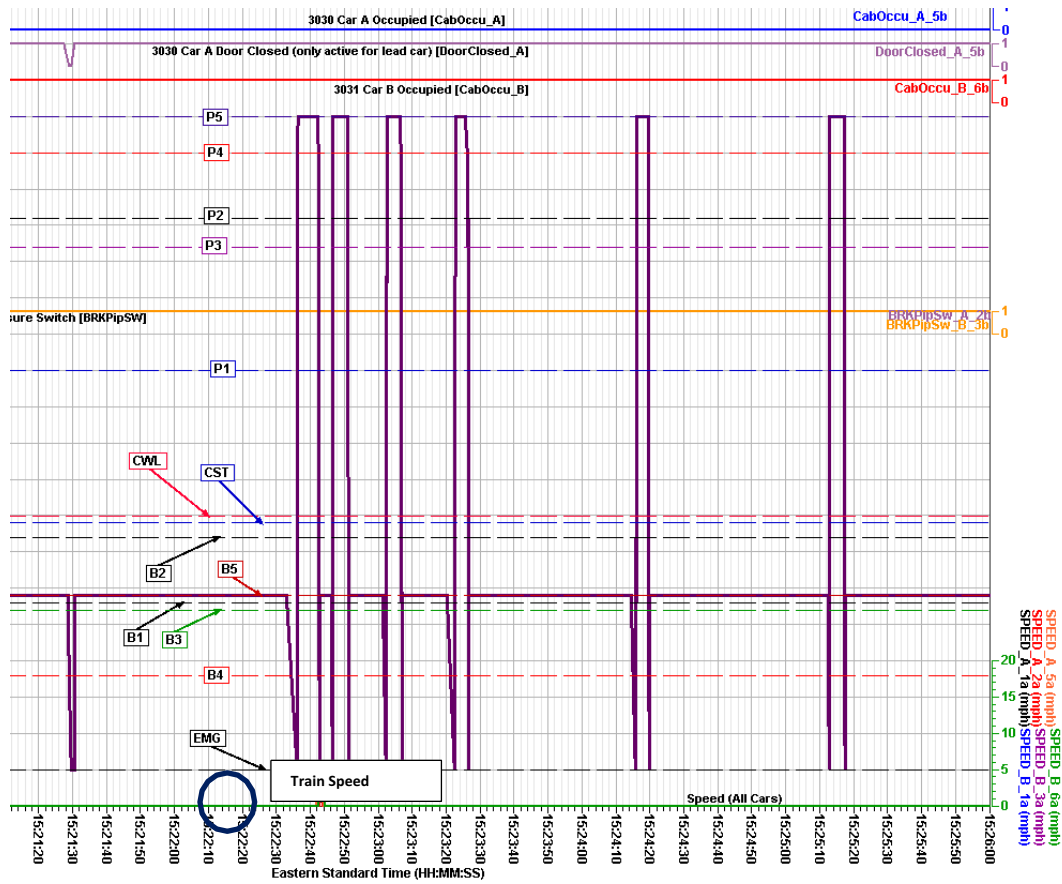


Figure 3- Event recorder plot showing MCP of train 302

The MCP is moved to the EMG position at 3:27:30 p.m. and returns to the B5 position at 3:28:06 p.m. At 3:32:27 p.m., the MCP is moved to the EMG position and car 3031 is keyed down. See figure 4.

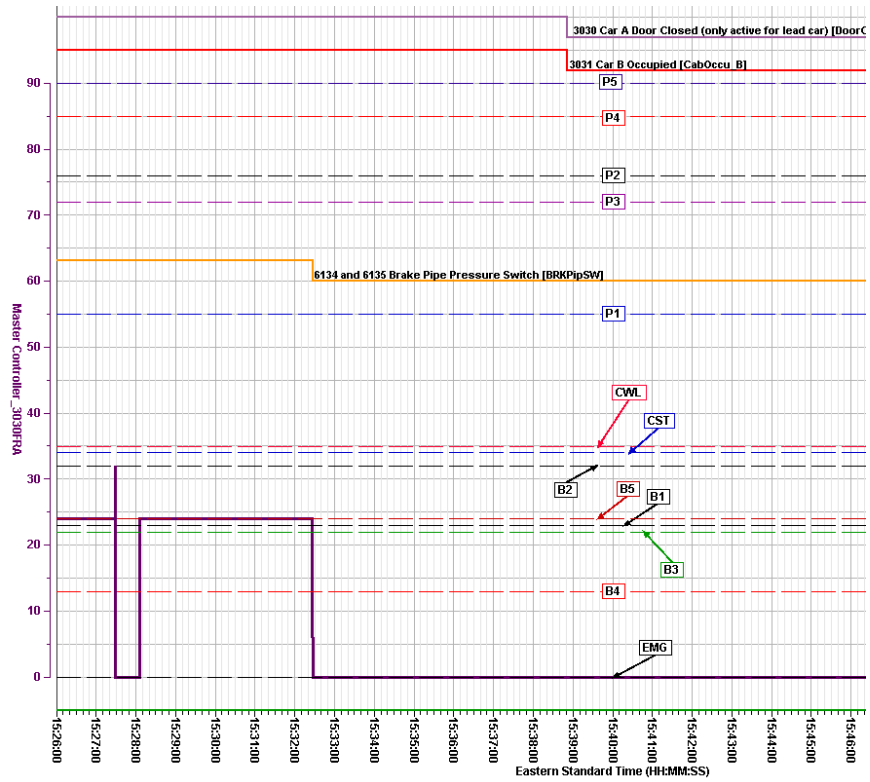


Figure 4-- Event recorder plot showing MCP of train 302

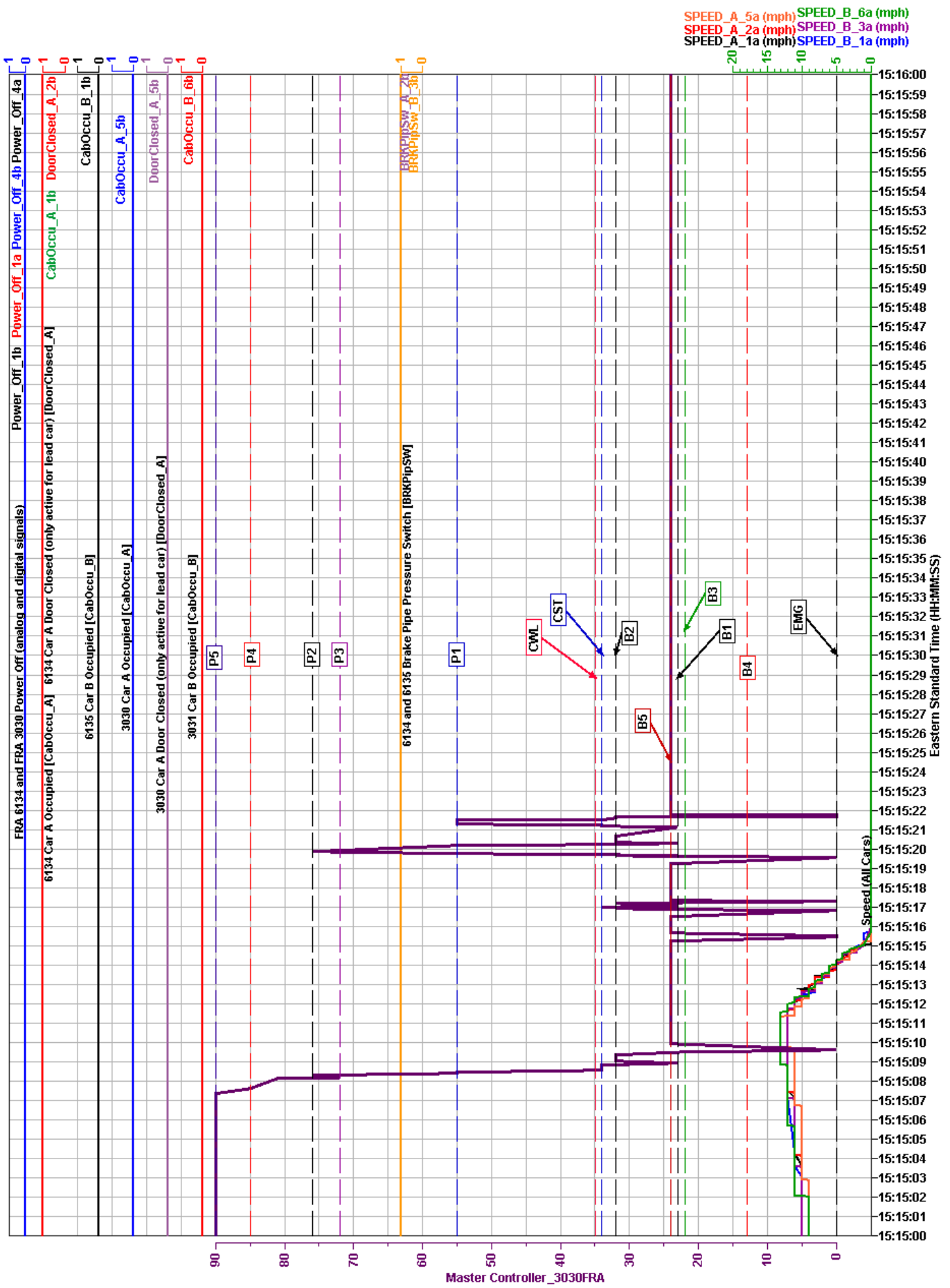
Plotted data is shown on pages 9 through 13 of this report.

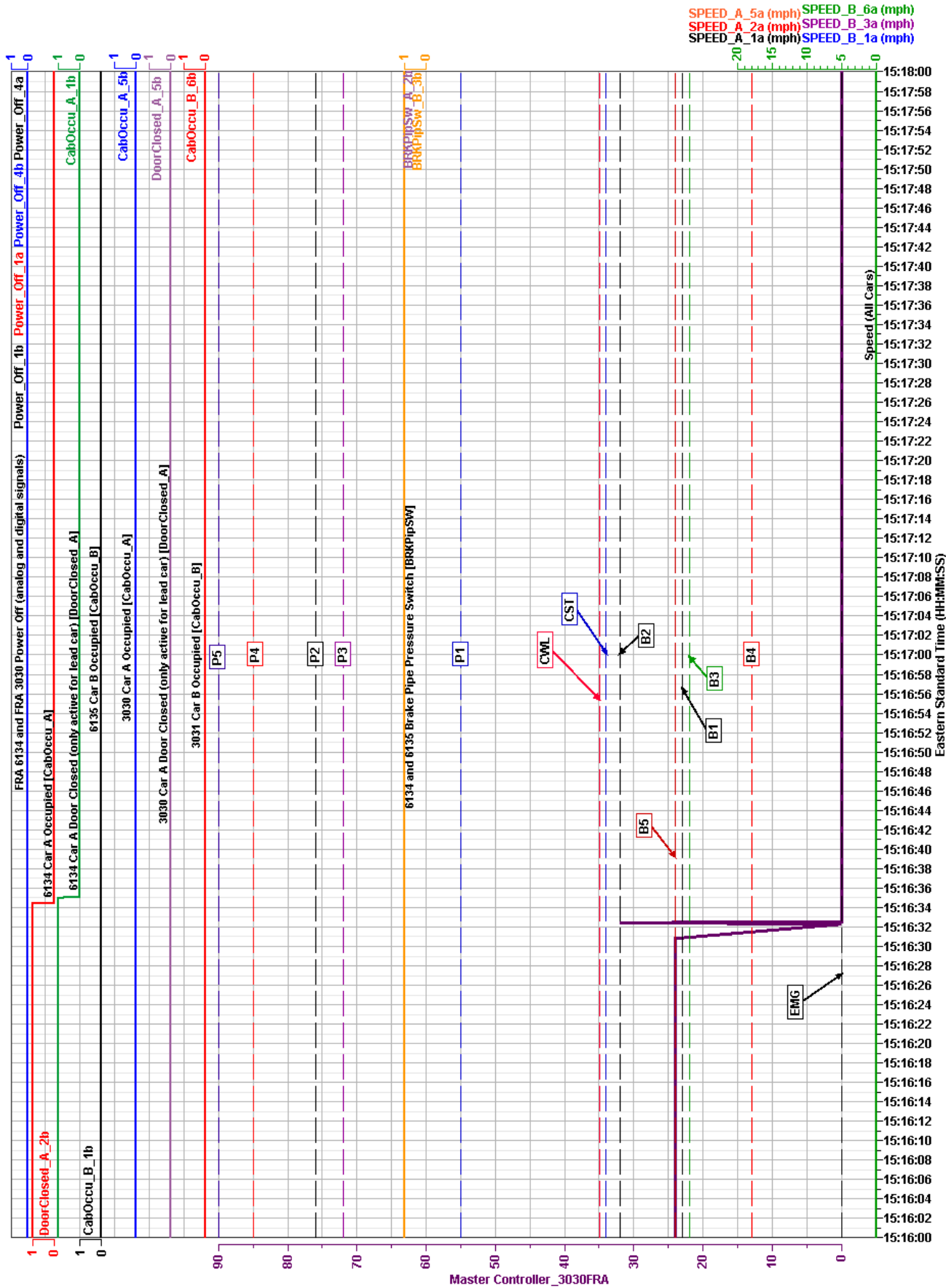
END OF FACTUAL REPORT

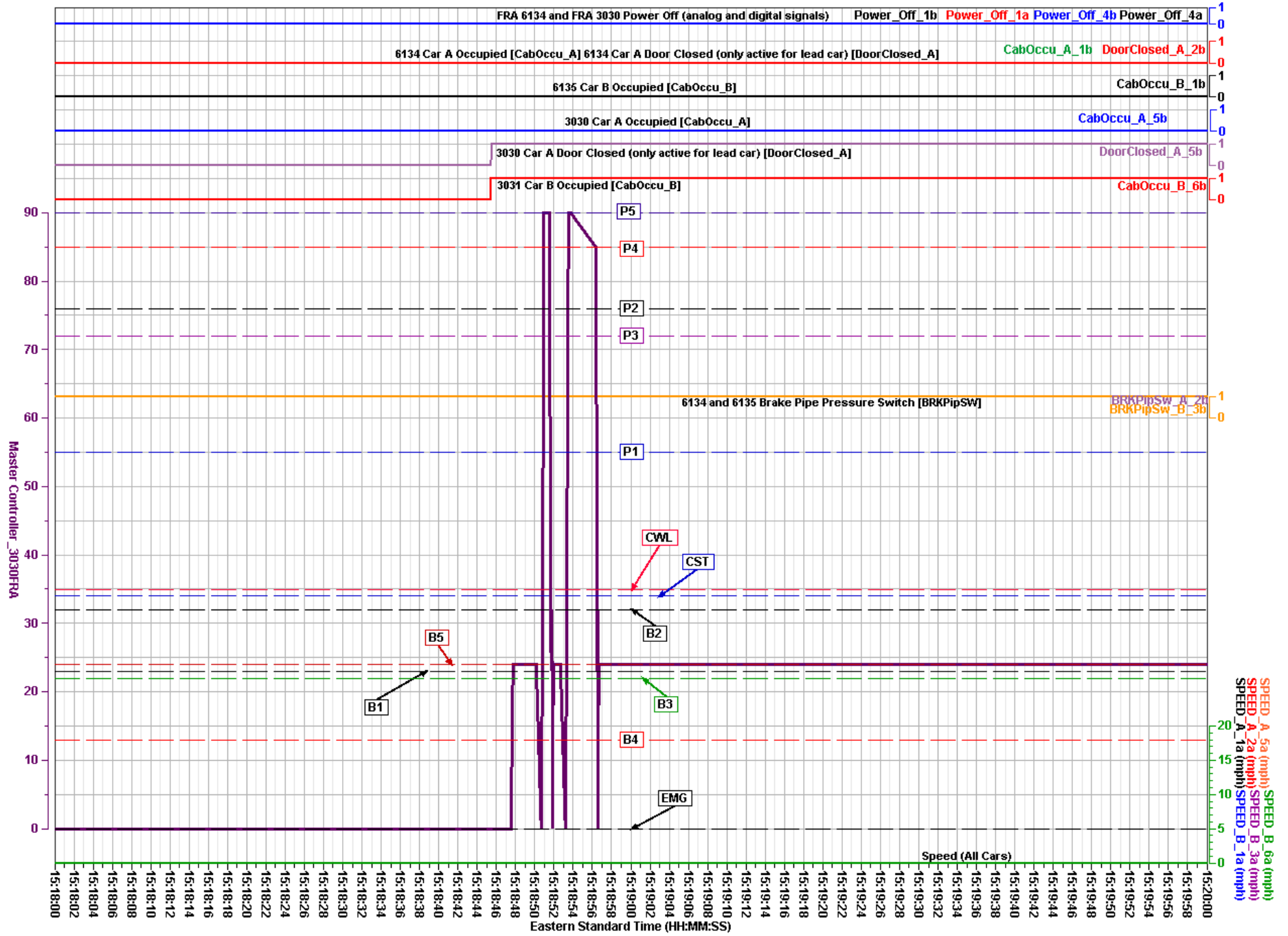
Attachment 1

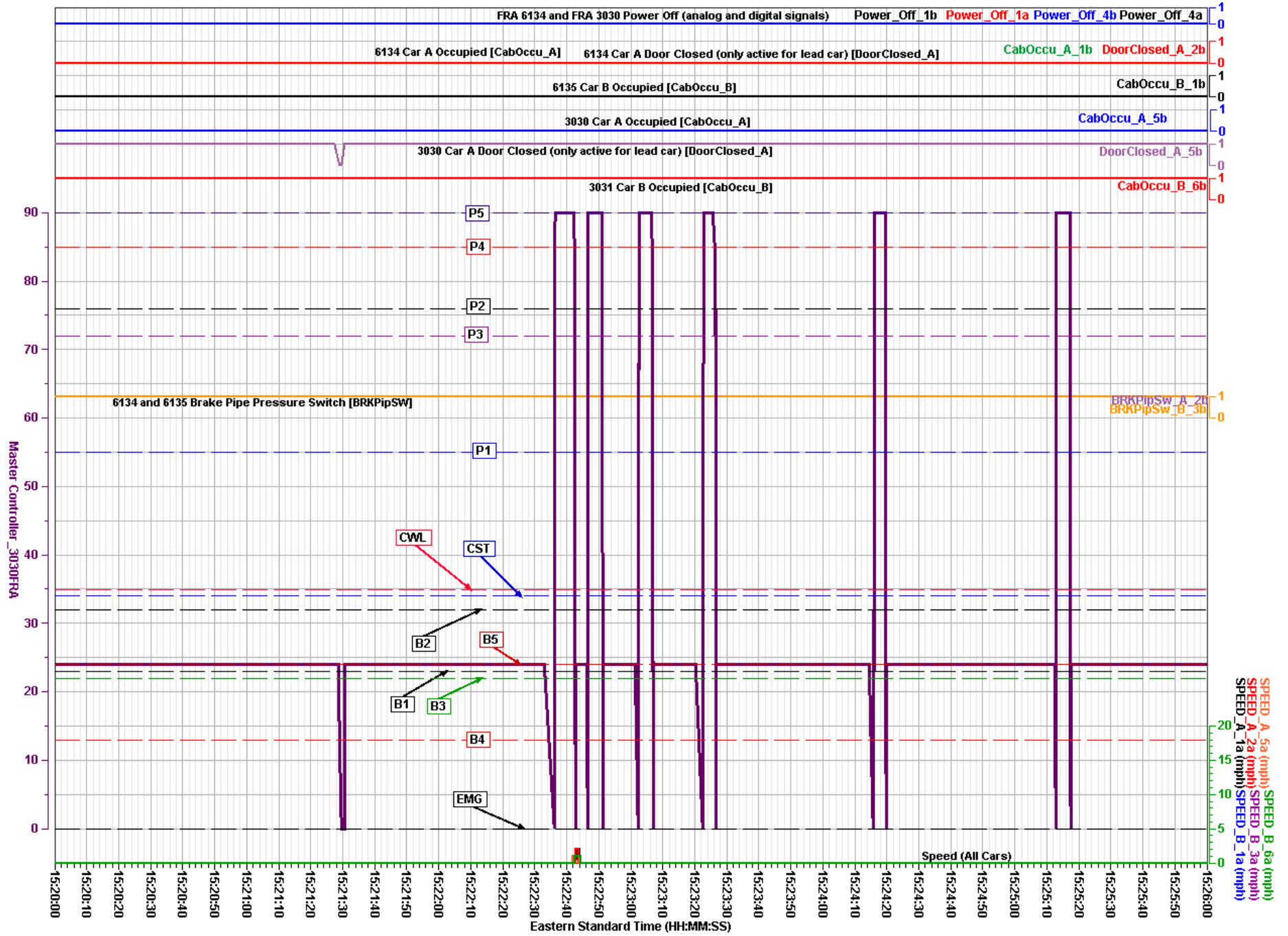
	13	12	11	10	9	8	7	6	5	4	3	2	1	Value	
Parameter Names Matrix Trainline Names	TL17_A 17- RCom	TL18 18-R1	TL19 19-R2	TL20 20-R3	TL21 21-R4	TL30_A 30-SW1	TL24_A 24-SW2	TL25_A 25-SF S1	TL26_A 26-PF S1	TL27_A 27-FS2	TL28_A 28-FS3	TL29_A 29-FSA	TL76_A 76-CR	Master Controller Value	Master Controller Position (MCP)
P5	1	1	1	1	1	1	1	1	1	1	1	1	0	90	P5
P4	1	1	1	1	1	1	1	1	1	1	0	0	0	85	P4
P3	1	1	1	1	0	1	1	1	1	0	0	0	0	72	P3
P2	1	1	1	1	0	1	1	1	0	1	1	1	0	76	P2
P1	1	0	1	1	0	1	1	1	0	0	0	0	0	55	P1
CWL (Car Wash)	1	0	1	1	0	0	0	0	0	0	0	0	1	35	CWL
CST	1	0	1	1	0	0	0	0	0	0	0	0	0	34	CST
B1	1	0	0	1	0	0	0	0	0	0	0	0	0	23	B1
B2	1	0	0	1	1	0	0	0	0	0	0	0	0	32	B2
B3	1	0	0	0	1	0	0	0	0	0	0	0	0	22	B3
B4	1	0	0	0	0	0	0	0	0	0	0	0	0	13	B4
B5	1	0	1	0	0	0	0	0	0	0	0	0	0	24	B5
EMG (Emergency)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	EMG

Table 1-Table of parameters to decode master controller position









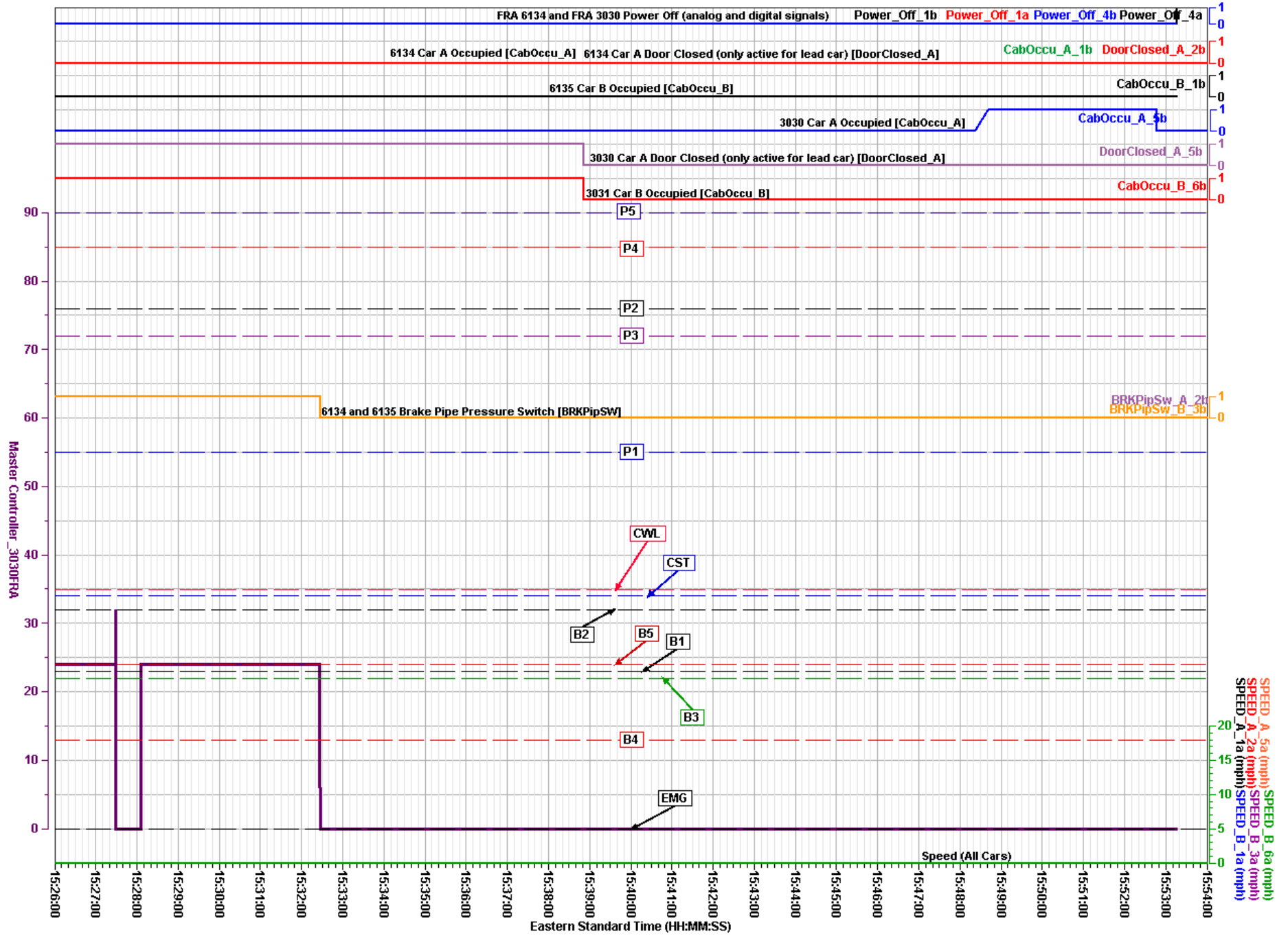
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Revised: 31 August 2015

15:20:00 to 15:26:00

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15:26:00 to 15:54:00

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