Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2018-1301

Union Pacific Railroad Company (UP) Collision
Granite Canon, Wyoming
October 4, 2018

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report, including this one, made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.

SYNOPSIS

On October 4, 2018, at 7:40 p.m., MDT, an eastbound Union Pacific Railroad Company (UP), mixed-freight train operating under Train Symbol MGRCY 04 (Train 1), struck the rear end of a standing eastbound UP mixed-freight train operating under the Train Symbol MPCNP 03 (Train 2). The rear end collision occurred on the UP-Denver Service Unit, Laramie Subdivision, at Milepost (MP) 527.12, near the town of Granite Canon, Wyoming, on Main Track No. 1. The method of operation is by a Traffic Control System (TCS), supplemented by Positive Train Control (PTC), and an Automatic Cab Signal System (ACS). The Laramie Subdivision is equipped with two main tracks.

Train 1, consisting of 3 lead locomotives, 95 loads, 10 empties, 12,417 trailing tons, and 6,581 feet in length, struck the rear of stopped Train 2. Because of the collision, the 3 lead locomotives and 57 cars of Train 1 and 8 cars of Train 2 derailed. There was a release of diesel fuel from the three locomotives of Train 1 and no release of any other hazardous materials because of the collision. The release of diesel fuel did not cause an evacuation of the surrounding area. The Federal Railroad Administration (FRA) reportable damages totaled $3,833,007. Damages consisted of equipment — $3,499,453 and track, signal and structure — $333,554.

The Engineer and Conductor of Train 1 sustained fatal injuries because of the collision. The Engineer and Conductor of Train 2 were off their train at the time of the accident and were uninjured.

Weather at the time of the accident, it was dark, cloudy, and 46 ºF.

The FRA investigation determined the probable cause of the accident was E03C — Obstructed brake pipe (closed angle cock, ice, etc.).

The FRA investigation also determined E09L — Other brake defects as a contributing factor.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2018-1301

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Union Pacific Railroad Company	UP	1018DV004
2. Name of Railroad Operating Train #2	**2a. Alphabetic Code**	**2b. Railroad Accident/Incident No.**
Union Pacific Railroad Company	UP	1018DV004

GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Union Pacific Railroad Company	UP	1018DV004
2. U.S. DOT Grade Crossing Identification Number	**3. Date of Accident/Incident**	**4. Time of Accident/Incident**
	10/4/2018	7:40 PM

5. Type of Accident/Incident
Rear End Collision

6. Cars Carrying HAZMAT	7. HAZMAT Cars Damaged/Derailed	8. Cars Releasing HAZMAT	9. People Evacuated	10. Subdivision
27	6	0	0	UNION PACIFIC RAILROAD C

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Granite Canon	527.12	WY	LARAMIE

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
46 ˚F	Dark	Cloudy	Main

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
Main Track 1	Freight Trains-60, Passenger Trains-80	2.9	East

23. PTC Preventable	24. Primary Cause Code	25. Contributing Cause Code(s)
No	[E03C] Obstructed brake pipe (closed	E09L

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FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2018-1301

OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	MGRCY04

4. Speed (recorded speed, if available) R - Recorded E - Estimated	Code	5. Trailing Tons (gross excluding power units)	6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter	Code
55.0 MPH	R	12417		0

6. Type of Territory

Signalization: Signaled

Method of Operation/Authority for Movement: Signal Indication

Supplemental/Adjunct Codes: A, Q, J

7. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box	Alcohol	Drugs
(1) First Involved *(derailed, struck, etc.)*	UP 5412	1	no		0	0
(2) Causing *(if mechanical, cause reported)*			no	9. Was this consist transporting passengers?		No

10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End e. Remote	11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Train	3	0	0	0	0	(1) Total in Equipment Consist	95	0	10	0	0
(2) Total Derailed	3	0	0	0	0	(2) Total Derailed	51	0	6	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
2831109	333554

Number of Crew Members				Length of Time on Duty	
14. Engineers/Operators	15. Firemen	16. Conductors	17. Brakemen	18. Engineer/Operator	19. Conductor
1	0	1	0	Hrs: 10 Mins: 55	Hrs: 10 Mins: 55
Casualties to:	20. Railroad Employees	21. Train Passengers	22. Others	23. EOT Device? Yes	24. Was EOT Device Properly Armed? Yes
Fatal	2	0	0	25. Caboose Occupied by Crew?	N/A
Nonfatal	0	0	0		

26. Latitude	27. Longitude
41.099654000	-105.132199000

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FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2018-1301

OPERATING TRAIN #2

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	MPCNP03

4. Speed (recorded speed, if available) R - Recorded E - Estimated	Code	5. Trailing Tons (gross excluding power units)	6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter	Code
0.0 MPH	R	13474		0

6. Type of Territory

Signalization: Signaled

Method of Operation/Authority for Movement: Signal Indication

Supplemental/Adjunct Codes: J, Q, A

7. Principal Car/Unit	a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box	Alcohol	Drugs
(1) First Involved *(derailed, struck, etc.)*	JRSX 1003	160	no		0	0
(2) Causing *(if mechanical, cause reported)*			no	9. Was this consist transporting passengers?		No

10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)	a. Head End	Mid Train b. Manual	Mid Train c. Remote	Rear End d. Manual	Rear End e. Remote	11. Cars (Include EMU, DMU, and Cab Car Locomotives.)	Loaded a. Freight	Loaded b. Pass.	Empty c. Freight	Empty d. Pass.	e. Caboose
(1) Total in Train	2	0	1	0	0	(1) Total in Equipment Consist	90	0	67	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	6	0	2	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
668344	0

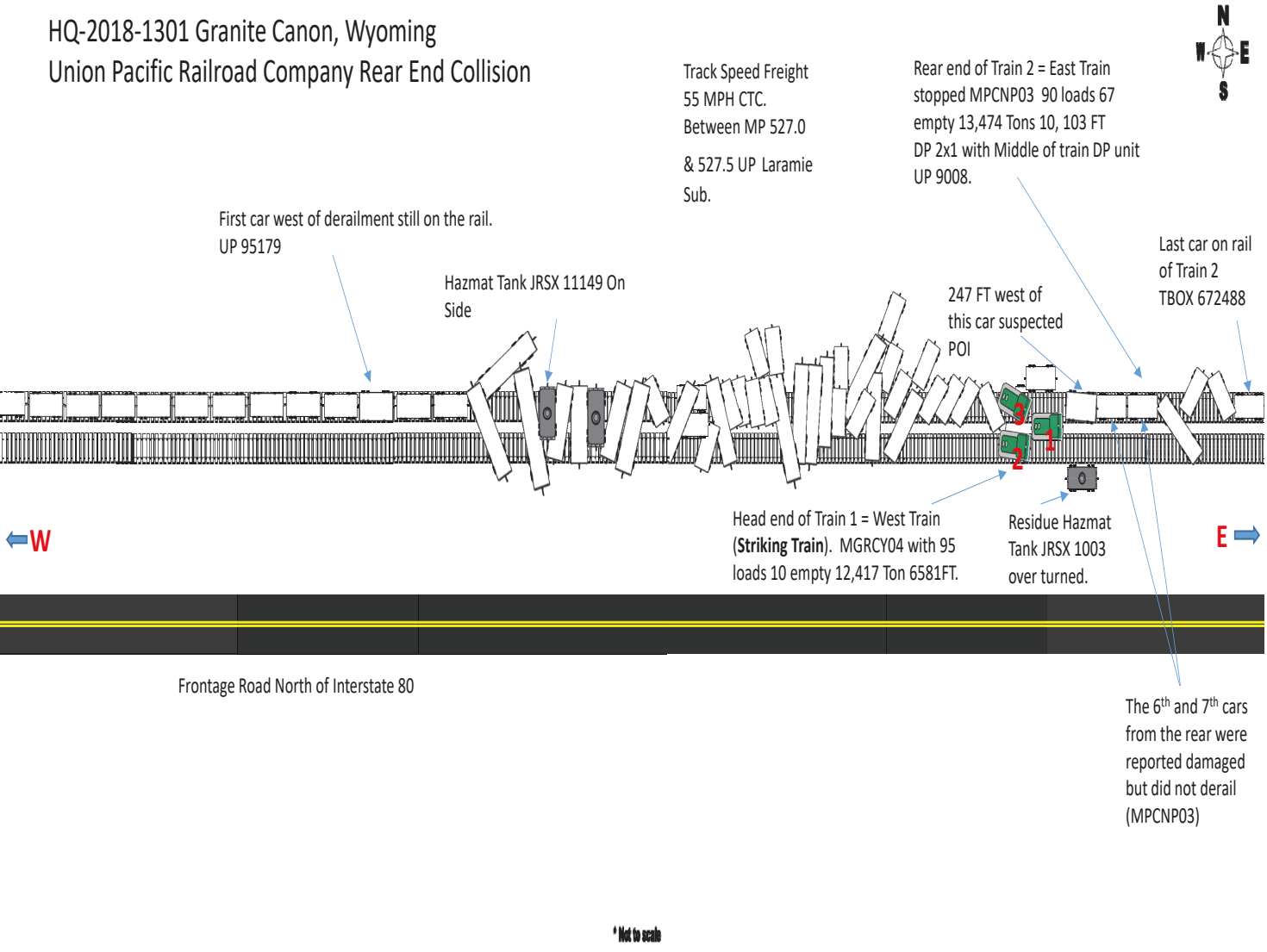
Number of Crew Members				Length of Time on Duty	
14. Engineers/Operators	15. Firemen	16. Conductors	17. Brakemen	18. Engineer/Operator	19. Conductor
1	0	1	0	Hrs: 10 Mins: 40	Hrs: 10 Mins: 40

Casualties to:	20. Railroad Employees	21. Train Passengers	22. Others	23. EOT Device?	24. Was EOT Device Properly Armed?
				Yes	Yes
Fatal	0	0	0	25. Caboose Occupied by Crew?	N/A
Nonfatal	0	0	0		

26. Latitude	27. Longitude
41.099654000	-105.132199000

SKETCHES

Sketch - Sketch HQ-2018-1301



NARRATIVE

CIRCUMSTANCES PRIOR TO THE ACCIDENT

Striking Train Symbol UP Train MGRCY 04 (Train 1)

The crew of Union Pacific Railroad Company (UP) freight train MGRCY 04 (Train 1) consisted of one locomotive engineer and one conductor. The crew went on duty at 8:45 a.m., MDT, on October 4, 2018, in Rawlins, Wyoming, which is the away-from-home terminal for both employees. Their assignment was to operate Train 1 from Rawlins to Cheyenne, Wyoming, via the Laramie Subdivision. Prior to being called to work, the Engineer was off duty for 11 hours, 30 minutes, and the Conductor was off duty for 11 hours, 56 minutes; this is more than the required statutory off-duty rest period. The assigned mixed freight train consisted of 3 lead locomotives, 76 loads, 10 empties, 9,935 trailing tons, and was 5,627 feet long.

The air brake inspection was conducted by qualified mechanical employees at Green River, Wyoming (WX817), on October 4, 2018, at 1 a.m., on the outbound train. Per locomotive documentation, a locomotive daily inspection was performed on the locomotives at 12:15 a.m., on October 4, 2018, at Green River. The crew of Train 1 departed Rawlins en route to Laramie, Wyoming, where they had orders to perform a 19-car pick up. As reflected by the locomotive download, the train's air brake system experienced air flow issues between Green River and Rawlins, with the cubic feet per minute (CFM) recorded at zero when the train encountered buff forces and returned to approximately 24 cfm when the train was running with normal draft forces.

On arrival at Laramie, the crew of Train 1 secured their train prior to proceeding into Yard Track 8 with their three lead locomotives. While in Yard Track 8, the crew coupled into the 19-car fill for their train and performed an initial terminal air brake test on these cars. This is verified by a UP Manager who was in Laramie during the time the crew was performing their work, along with the Federal Railroad Administration's (FRA) review of locomotive downloads. After the initial terminal air brake test on the 19-car fill, the crew pulled back out onto Main Track 2 to return to their train. After coupling back into their train, the crew of Train 1 made a Class 3 trainline continuity inspection on the entire train. Train 1 departed Laramie at 4:46 p.m. with 3 lead locomotives, 95 loads, 10 empties, 12,417 tons, and was 6,581 feet in length.

The Laramie subdivision dispatcher assigned Train 1 a route east from Laramie, on Main Track 2 and at Hermosa crossed them over to Main Track 1. After departing Laramie, Train 1 did not stop until the accident. Event recorder data from the lead locomotive of the striking train showed changes in the air flow from the locomotive to the brake pipe at specific locations. Between Milepost (MP) 550 and MP 545, the grade changed from ascending to descending and returned to ascending. To control the train speed, the Engineer went from power to dynamic braking, and then back to power to negotiate the change in grade. This caused the train slack forces to change from draft to buff as the train entered the descending grade, and the air flow changed from 24 cfm to a recorded 0 cfm. When the Engineer reapplied the

power on the ascending grade at MP 544, the train slack force was changed from buff to draft, and the air flow returned to about 24 cfm. At this location, the Engineer was able to control the train without using the pneumatic train brakes.

At approximately 7:10 p.m., Train 1 crested the grade at MP 540 (Sherman Hill); the Engineer applied dynamic braking to control the train speed. Because of UP's Tons Per Operative Brake (TPOB) Rule and Tons Per Dynamic Brake Axle (TPDBA) Rule, the train was restricted to 25 mph. The Engineer applied a minimum brake application of 5-7 pounds per square inch (psi) reduction at approximately 7:19 p.m. at MP 536.68, while traveling at 19 mph. At MP 531.80, the Engineer increased the brake pipe reduction to a total of 10 psi while still traveling at 19 mph. At MP 531.3, the speed had increased to 25 mph and the Engineer increased the total brake pipe reduction to 17 psi. At MP 531.09, the Engineer increased the brake pipe reduction to 26 psi (full service application) and the train had increased to 26 mph. At MP 530.85 the train was still accelerating reaching 28 mph when the Engineer applied an emergency application at 7:35 p.m.

On the UP-Denver Service Unit, Laramie Subdivision, the method of operation is via a Traffic Control System (TCS), supplemented by Positive Train Control (PTC) and an Automatic Cab Signal System (ACS) with two main tracks. The maximum authorized speed from MP 509.5 to MP 565.3 for both Main Tracks 1 and 2 is 55 mph, as designated in the current North Platte Area Timetable No. 5, dated December 11, 2017. The maximum authorized speed for Train 1 was restricted to 50 mph between Green River (MP 817) and Cheyenne (MP 510) due to being designated a Key Train and was restricted to 25 mph between Buford MP 536 and Cheyenne MP 511 on Main Tracks 1 and 2 because of the TPOB and TPDBA Rules. From MP 540 to MP 527, Train 1 was operating on a descending 1.5 percent grade.

The railroad timetable and geographic direction is east. Timetable direction is used throughout this report.

Weather at the time of the accident was dark, cloudy, and 46º F.

Train Symbol UP Train MPCNP 03 (Train 2)

The crew of UP freight train MPCNP 03 (Train 2) consisted of an engineer and a conductor. The crew went on duty at 9 a.m., MDT, on October 4, 2018, in Rawlins, which is the away-from-home terminal for both employees. Their assignment was to operate Train 2 from Rawlins to Cheyenne, via the Laramie Subdivision. Both crew members received more than the statutory off-duty period for rest prior to reporting for duty. Their assigned mixed freight train consisted of two lead locomotives, one mid-train Distributive Power locomotive (DPU), 90 loads, 67 empties, 13,474 tons, and was 10,103 feet in length. Train 2 was traveling at about 20 mph when the dispatcher made the emergency announcement about a runaway train. The Engineer of Train 2 made an emergency brake application, and stopped the train at MP 525.3. Both crew members dismounted Train 2 and moved up into the clear by Interstate 80 prior to the accident.

THE ACCIDENT

Train 1:

On October 4, 2018, at 7:40 p.m., MDT, Train 1 struck the rear end of Train 2. The rear-end collision occurred on the UP-Denver Service Unit, Laramie Subdivision, at MP 527.12, near the town of Granite Canon, Wyoming, on Main Track 1. Because of the collision, the 3 lead locomotives and 57 cars of the striking train were derailed. The three locomotives of Train 1 released diesel fuel with no release of any other hazardous materials because of the collision.

No review of the outward or inward cameras were performed due to the power source being removed from cameras on the UP 5412 at Green River, on October 3, 2018, for an unknown reason. The crew of Train 1 had communicated with the Laramie subdivision dispatcher via the radio and informed the dispatcher of their trouble at which time the dispatcher placed an “Emergency, Emergency, Emergency” runaway equipment call out over the Radio Channel 24 - 24.

The Train 1 Engineer initiated the emergency air brake application at a recorded speed of 28 mph. Train 1 traveled almost 4 miles after the Engineer initiated the emergency air brake application before impacting the rear of Train 2 at a recorded speed of 55 mph. Train 1 traveled through the rear of Train 2 after impact; and the locomotives came to rest on their sides, heavily damaged across Main Tracks 1 and 2.

The Engineer and the Conductor of Train 1 both incurred fatal injuries because of the collision.

Train 2:

Cars 1 through 5, 8, 9, and 10 from the rear of Train 2 derailed as a result of the collision. The 6th and 7th cars from the rear were reported damaged by UP but did not derail. The crew members of Train 2 heard the dispatcher calling, “Emergency, Emergency, Emergency runaway train,” on Radio Channel 27 – 27. The crew members were able to secure the train and get clear of their train in a safe area close to Interstate 80 prior to the collision.

Immediately following the accident, emergency response personnel began arriving from the following agencies: Laramie County Emergency Management Agency, Laramie County Fire Department, Laramie County Sheriff’s Office, Wyoming Highway Patrol, and F.E. Warren Air Force Base.

Numerous UP employees were also dispatched to ascertain the condition of the accident scene, inventory damages, aid in recovery, and determine remediation.

FRA reportable damages totaled $3,833,007. Damages consisted of equipment — $3,499,453 and track, signal and structure — $333,554.

POST-ACCIDENT INVESTIGATION

On October 4, 2018, FRA began an investigation of this accident/incident. FRA assigned Operating Practices, Motive Power & Equipment, Track, and Signal and Train Control Inspectors; and a Mechanical Engineer, Chief Inspector, and a Deputy Regional Administrator to the accident investigation scene.

Upon commencing its investigation, FRA investigators inspected the accident site, reviewed toxicology analysis, fatigue analysis of the striking train's crew, and rules compliance.

After their on-site inspection and investigation, FRA in conjunction with the National Transportation Safety Board (NTSB), conducted interviews with the train crew of the standing train, the dispatcher (interviewed by telephone), and local supervisory personnel. FRA's investigators also requested and received all records, forms, and other documentation necessary to conduct their final analysis and draw conclusions concerning the pertinent facts of the accident/incident. The following analysis and conclusions, as well as any possible contributing factors and the probable cause in this report, represent the findings of FRA's investigation.

ANALYSIS AND CONCLUSIONS

Analysis - Toxicological: The crew members of both Train 1 and Train 2 were tested under Title 49 of the Code of Federal Regulations (CFR) Part 219 Subpart C, Post-Accident Toxicological Testing. FRA test results were negative.

NTSB performed additional toxicology testing at the Federal Aviation Administration (FAA) Forensic Sciences laboratory. The independent testing revealed previous use of “Kratom,” a drug derived from a plant grown in Southwest Asia, and several other prescription allergy medications. None of the drugs reported positive by NTSB are among the 39 substances tested for by FRA in its post-accident testing program.

FRA investigators determined the operation of the train could not have prevented the accident, and therefore any potential impairment of drugs could not have contributed to the accident.

Conclusion: FRA determined drugs and alcohol did not contribute to the cause or severity of the accident.

Analysis - Fatigue: FRA performed a fatigue analysis using the Fatigue Avoidance Scheduling Tool (FAST). FRA uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis. At or above this baseline, FRA does not consider fatigue as probable for any employee. Inputs into the FAST software vary based on information obtained from each employee.
FRA obtained fatigue-related information, including a 10-day work history for the crew of Train 1. FRA concluded fatigue was not probable for either employee.

Conclusion: FRA determined fatigue did not contribute to the cause or severity of the accident.

Analysis - Train 1 Crew Operating Performance: The lead locomotive of Train 1 was equipped with a speed indicator and event recorder as required. The recorder data was downloaded and analyzed by the investigation team. The crew of Train 1 was in compliance with applicable railroad operating rules and train-handling requirements. The crew complied with all radio procedures when they informed the Laramie subdivision dispatcher of their loss of air brakes and the train not slowing. The crew continued to work to bring their train to a stop, and downloads reflect that someone in the lead locomotive was still at the controls up to 33 seconds prior to impact with Train 2. FRA investigators reviewed operational testing records for the crew of Train 1 for the previous six months. UP had properly monitored their employees in the field and adequate operational testing was conducted.

Conclusion: FRA determined the performance of Train 1's crew did not contribute to the cause or severity of the accident.

Analysis - Train Line: Train 1 received a Class I air brake test on October 4, 2018. The lead locomotive had no open defects.
A Class I brake test was performed on the 19 cars picked up at Laramie by the crew of Train 1, and observed by a UP manager, with no exceptions. Additionally, the crew performed the required Class III train line continuity test on the entire train prior to departure. Train 1 passed a warm/cold wheel detector at MP 527.6 that indicated elevated wheel temperatures near the head end of the train. The derailment investigation later revealed indications of overheated wheels in the general pileup that corresponded with the head of the train. The locomotive air brakes and air brake system on the head 19 cars appeared to work properly, while the brakes on the rest of the train did not produce an emergency application as requested by the Engineer.

The investigation identified a suspect intermediate air hose which exhibited signs of kinking on the "A" end of Car SSW 87597. Car SSW 87597 was the first car behind the locomotives out of Green River and the 20th car from the locomotives after the Laramie pickup. The air hose was captured, and the investigation team determined there was a disproportionate amount of damage in relation to the manufacture date of the hose. The air hose was manufactured in fourth quarter 2017 and stamped with a manufacture date of first quarter 2018, in accordance with Association of American Railroads (AAR) standards. The air hose was installed on SSW 87597 on November 7, 2017. This type of deformation is known to restrict airflow through the train line and prevent brake application. The suspect hose, and the hose from the B end of SSW 87597, were removed and shipped to Strato, Inc. in Piscataway, New Jersey, for testing. The investigation team agreed an examination of the hose support showed the support chain did not move along the length of the hose before, or during the accident. Installation instructions for the hose support require it to be placed within the first one-third of the hose nearest the angle cock. The hose support was located beyond the centerline of the hose. Additionally, the hose support bracket was broken prior to the accident rendering it ineffective.

The investigation team met at UP Council Bluff Yard to inspect exemplar cars to gather additional information for the testing to be performed at Strato.

Testing with an exemplar hose recreated obstructed flow scenarios. Air flow through an obstructed hose was recorded as 24 cfm. The team received data from the locomotive manufacturer that a flow below 20 cfm is displayed and recorded as 0 cfm on the event recorder. This data is consistent with the observations made in the field.

The air hose was then shipped to Parker Hannifin Corporation in Wickliffe, Ohio, for integrity testing. The test results confirmed the inside of the air hose had no visible damage and no defects from the manufacturing process.

Conclusion: FRA determined the restricted air flow near the head end of Train 1 did not allow the train's brakes to function properly, and was the probable cause of the accident. (Cause code: E03C)

Analysis – EOTD Communication: When the Engineer initiated an emergency brake application, the lead locomotive of Train 1 sent a signal to the end-of-train-device (EOTD), UPRQ 65471. Investigators reviewed the event recorder data from the lead locomotive on site and observed the brake pipe pressure on the head end was 0 psi, while the pressure at the EOTD was measured at 75 psi. Additionally, the event recorder data indicated a front to rear loss of communication with the EOTD. The EOTD did not receive the front to rear communication to open the EOTD brake valve and place the train into emergency from the rear.

Data retrieved from the lead locomotive and the EOTD indicate that at the time of the emergency application, the locomotive had not yet displayed a front-to-rear no communication signal to the Engineer. Investigators were able to pinpoint the location of the lead locomotive and EOTD at the moment the train was placed in emergency. Investigators then plotted the locations of each on a topographical map and identified that topography in that area may have prevented the signal from the locomotive being received by the EOTD. FRA requested a history of communication failures on similar trains, and in this location, as identified by locomotive maintenance logs. UP provided 10 months of data for the Laramie Subdivision identifying 378 communication failures, of which 25 were at the same location. Despite the frequency of the communication failures, UP was unaware of the issue because the minimum requirement of the regulation Title 49 CFR 232.407(g) requires a loss of communication from the locomotive to the EOTD to occur for 16 minutes and 30 seconds before the failure is displayed to the crew.

The EOTD was tested by UP, and observed by FRA, in Council Bluffs, Iowa. Testing concluded the EOTD functioned as intended. The head-of-train device (HOTD) was then shipped to WABTEC in Germantown, Maryland. An exemplar EOTD was manually put in a front-to-rear no communication status and an emergency application was requested. Per the AAR standard, after the HOTD attempts to communicate the emergency application without a response from the EOTD for 15 seconds, a communication failure is displayed to the crew and the HOTD will continue to request an emergency application for an additional 1 minute and 45 seconds before stopping the emergency application

request. Testing confirmed the HOTD and EOTD operated as designed.

Conclusion: FRA determined the EOTD communication failure contributed to the cause and severity of the accident. (Cause code: E09L)

Analysis – Equipment Condition: FRA investigators reviewed maintenance records and performed a physical inspection of the cars not derailed. No exceptions were found of the non-derailed equipment that would have contributed to the cause or severity of the accident. Maintenance records of the locomotives demonstrated appropriate maintenance and inspections were performed.
FRA investigators identified eight of the cars being picked up in Laramie had been in storage and were overdue for a single car air brake test. Based on simulation results and physical evidence, the brakes on these cars did apply. Therefore, FRA concluded the past due single car air brake tests did not contribute to this accident.

Conclusion: FRA determined equipment condition did not contribute to the cause or severity of the accident.

Analysis - Track and Signal Tests/Inspections Performed and Results: Track and signal inspections of the track structure and signal system were reviewed by FRA, NTSB, and UP. FRA concurred with the NTSB and UP that the track and signal systems were working properly and were not factors in the accident.

Conclusion: FRA determined the track and signal system did not contribute to the cause or severity of the accident.

Analysis – Simulation: FRA contracted a simulation of the accident utilizing the Train Energy and Dynamics Simulator (TEDS). Values were taken from the event recorder downloads, train profile, and physical characteristics of the track to recreate the accident. The simulation was run with the obstructed train line in positions 10, 14, 17, 20, and 23. In all five scenarios, Train 1 would have struck the rear of Train 2 due to the lack of brake system functionality. The scenario with the obstructed train line between the 19th and 20th car provided almost an exact match to the recorded train speed at impact. The simulation also confirmed that had the EOTD initiated an emergency application on the rear as requested, Train 1 would have stopped approximately 3.5 miles prior to impacting Train 2.

Conclusion: FRA confirmed the obstruction in the train line was between the 19th and 20th car.

OVERALL CONCLUSIONS

The FRA investigation concluded a restriction in the train line between the 19th and 20th car reduced the airflow enough that the brakes behind the restriction did not apply. An emergency brake application was initiated by the Engineer but failed to apply to the entire train due to the restricted train line. Additionally, a communication failure between the HOTD and EOTD prevented an emergency brake application from

the rear of the train. This scenario was replicated by the TEDS simulation and has been observed in other instances.

PROBABLE CAUSE AND CONTRIBUTING FACTORS

The FRA investigation determined the probable cause of the accident was E03C — Obstructed brake pipe (closed angle cock, ice, etc.).

The FRA investigation also determined E09L — Other brake defects as a contributing factor.