Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch

Accident Investigation Report
HQ-2019-1329

Union Pacific Railroad Company (UP) Derailment
Lynndyl, Utah
March 30, 2019

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 Saturday, March 30, 2019, at approximately 9:06 a.m., MDT, a westbound Union Pacific Railroad Company (UP) manifest train MOGWC-29 derailed 24 cars at approximately Milepost (MP) 686.5 on UP's Lynndyl Subdivision, Rocky Mountain Service Unit. This derailment occurred in a remote area of Juab County, Utah, approximately 20 miles east of Lynndyl, Utah. The train consisted of 5 locomotives on the head-end and 2 locomotives cut in mid-train as the Distributed Power Units (DPU) with 139 loads, 26 empties weighing 19,019 trailing tons and 11,208 ft. in length.

At the time of the derailment the train was traversing a 0.80-percent downhill grade on tangent track and was in dynamic brake with the PTC system cut in, maintaining a speed of 35 mph. The maximum authorized timetable speed in this part of the railroad is 60 mph but was further restricted to 50 mph. Of the 24 cars that derailed, 12 contained hazardous materials, and at least one of the cars containing a hazardous material, Propane, UN 1075, was leaking.

No injuries or evacuations were ordered. The damage estimates are $413,316 to the track; $226,842 to the signal system; and $1,502,035 to equipment.

At the time of the accident, it was daylight and clear with a temperature of approximately 50 °F.

The Federal Railroad Administration (FRA) determined the probable cause of the derailment was E06C, brake valve malfunction (stuck brake, etc.).

Additionally, contributing causes to the derailment were H995, Human factor - motive power and equipment, and H999, Other train operations/human factors.

U.S. Department of Transportation
Federal Railroad Administration

FRA FACTUAL RAILROAD ACCIDENT REPORT

FRA File #HQ-2019-1329

TRAIN SUMMARY

1. Name of Railroad Operating Train #1	1a. Alphabetic Code	1b. Railroad Accident/Incident No.
Union Pacific Railroad Company	UP	0319RM047

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	0319RM047

2. U.S. DOT Grade Crossing Identification Number	3. Date of Accident/Incident	4. Time of Accident/Incident
	3/30/2019	9:06 AM

5. Type of Accident/Incident
Derailment

6. Cars Carrying HAZMAT	7. HAZMAT Cars Damaged/Derailed	8. Cars Releasing HAZMAT	9. People Evacuated	10. Subdivision
18	12	4	0	UNION PACIFIC RAILROAD C

11. Nearest City/Town	12. Milepost *(to nearest tenth)*	13. State Abbr.	14. County
Lynndyl	686.5	UT	JUAB

15. Temperature (F)	16. Visibility	17. Weather	18. Type of Track
50 ˚F	Day	Clear	Main

19. Track Name/Number	20. FRA Track Class	21. Annual Track Density *(gross tons in millions)*	22. Time Table Direction
Single Main	Freight Trains-60, Passenger Trains-80	32.2	West

23. PTC Preventable	24. Primary Cause Code	25. Contributing Cause Code(s)
No	[E06C] Brake valve malfunction (stuc	H995, H999

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OPERATING TRAIN #1

1. Type of Equipment Consist:	2. Was Equipment Attended?	3. Train Number/Symbol
Freight Train	Yes	MOGWC-29

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
35.0 MPH	R	19019		0

6. Type of Territory

Signalization: Signaled

Method of Operation/Authority for Movement: Signal Indication

Supplemental/Adjunct Codes: Q

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.)*	MP 650466	19	no		0	0
(2) Causing *(if mechanical, cause reported)*	MP 650466	19	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	5	0	2	0	0	(1) Total in Equipment Consist	139	0	26	0	0
(2) Total Derailed	0	0	0	0	0	(2) Total Derailed	20	0	4	0	0

12. Equipment Damage This Consist	13. Track, Signal, Way & Structure Damage
1502035	640158

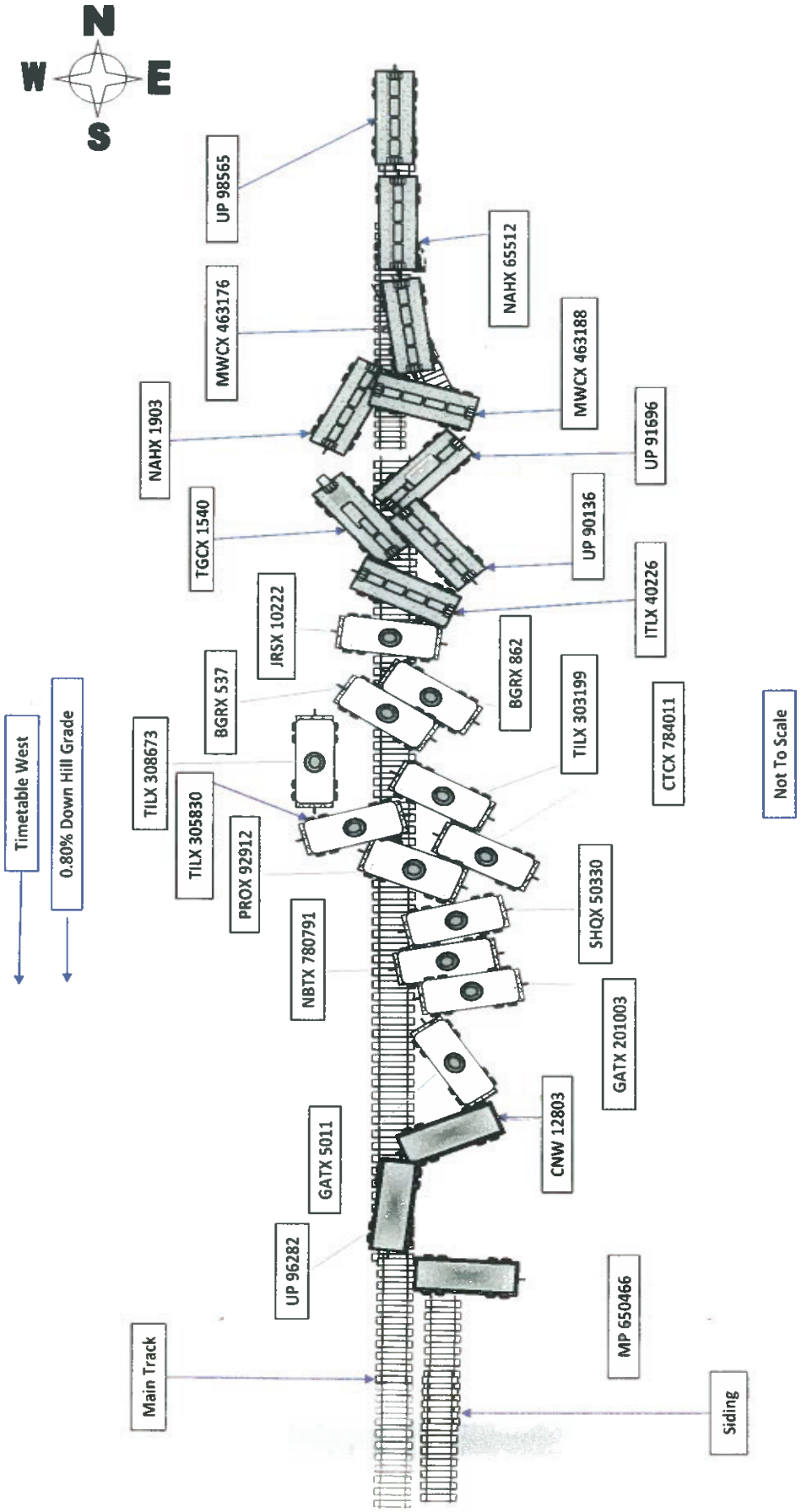
Number of Crew Members				Length of Time on Duty	
14. Engineers/Operators	15. Firemen	16. Conductors	17. Brakemen	18. Engineer/Operator	19. Conductor
2	0	1	0	Hrs: 5 Mins: 43	Hrs: 5 Mins: 43

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
39.756750000	-112.200068000

SKETCHES

Sketch - Lynndyl Sketch



NARRATIVE

For clarity and uniformity in this report, directions will be given per timetable directions for east and west and times will be given in Mountain Daylight Time (MDT).

Circumstances Prior to the Accident

Train 1 – UP Train MOGWC-29 (Short Pool Crew)

The crew of the MOGWC-29 (Train 1), consisting of a locomotive engineer and conductor, went on duty at 5 p.m., Friday, March 29, 2019, at Ogden, Utah. This was their home terminal and both had received more than the statutory off-duty time prior to reporting for duty.
The crew was the Short Pool crew from Ogden to Salt Lake City, Utah, and it was their job to assemble the train, take it to Salt Lake City and turn it over to the Long Pool crew. The crew was delayed getting on their locomotives until 9 p.m. because the locomotives were being serviced. After servicing was completed, they boarded their locomotives and began to put their train together. The train had already received a brake test by the car department. The crew had five head-end locomotives and two locomotives for mid-train distributed power units (DPU). The DPU locomotives were set into yard track 11, and five lead locomotives in track 10 were coupled to the head 83 cars of the train. The crew then went back to the DPU locomotives located in yard track 11 for coupling at mid-train in yard track 22 and completed the assembly of their train.

Train 1 now consisted of five head-end locomotives and two mid-train DPU locomotives with 139 loads and 26 empties, for 19,019 tons and 11,208 ft. in length.

At approximately 12:30 a.m., Train 1 departed Ogden on the Salt Lake Subdivision and was heading west toward Salt Lake City. As the train approached the Union Pacific Railroad (UP) North Yard, they were routed down main track 3 at CPC788. Between CPC788 and Milepost (MP) 785.0, Train 1 was observed by the crew of a train on adjacent main track 2 during a roll-by inspection. That crew observed a car that was creating sparks on main track 1 and called the Roper yardmaster and informed him that Train 1 had an open-top gondola car approximately 15 to 25 cars from the head end that was sparking. The Roper yardmaster then notified Train 1's crew of the sparking car and they brought the train to a stop on main track 3 at MP 784.3. Train 1's conductor then notified the dispatcher that they were told they had a sparking car in their train. After stopping, the conductor walked the train inspecting the cars for hot wheels/hot journals and made sure that the hand brakes had been released. When the conductor got to car MP 650466, an empty gondola, which was the 19th car in the consist, he did not use a heat-measuring device, known as a tempil stick, but noted that the wheels on the "B" end were hot on both sides of the car. Prior to directing the engineer to perform a set and release, he ensured that the handbrake was released. The conductor then instructed the engineer to release the brakes and noted the brake pad came off the wheel. Unsure what caused the wheel to become hot, the engineer suggested it could have been a sticking brake and they could try another set and release. He then instructed the

engineer to re-apply the brakes, at which point the engineer made a 20 lbs. reduction on the brake pipe. Once applied, the engineer released the brakes and again observed the brake pad came off the wheel. At this point, the conductor made his way back to the head end of the train for further instructions.

The Roper yardmaster stated he would call the car foreman to inspect the subject car. Upon arrival to the train, the car foreman determined he could not inspect the car at this location due to the rear end of the train blocking a crossing to a right of way access point and swampy terrain conditions preventing approach from the head end of the train. The car foreman then notified the Roper yardmaster that he could not inspect the train at this location and asked the yardmaster what the crew found. The yardmaster stated he did not know what the crew found and the car foreman suggested if the train needed to be inspected, it could be done at Garfield.

After approximately one hour, Train 1's crew was instructed to proceed to the SLC Intermodal Terminal at MP 777.75 for a crew change and arrived at approximately 5:05 a.m. According to interviews after the incident, the crew thought the car foreman had resolved the problem. The investigation revealed the car foreman did not inspect the car because he was unable to access it due to the swampy terrain from heavy rain. They then took the train to the SLC Intermodal Terminal for a crew change as instructed.

Train 1 (Long Pool Crew)
A UP Long Pool crew, consisting of an engineer and a conductor, went on duty on March 30, 2019, at 3:30 a.m. Both had received more than the statutory off-duty time prior to reporting for duty. Once on duty, the conductor called the dispatcher for instructions and was notified that their train was currently stopped for a report of a sparking car and that the carmen were looking at it.

At the SLC Intermodal Terminal, the Long Pool crew boarded the train and told the dispatcher they were ready to depart. They departed at approximately 5:11 a.m. and proceeded westbound toward Milford, Utah, on the Lynndyl Subdivision. The engineer was operating the train with the PTC activated and trip optimizer engaged. However, at MP 698.7, the engineer turned off the trip optimizer because the speed of their train had dropped down to 19 mph.

At the time of the accident, it was daylight and clear with a temperature of approximately 50 °F.

The Accident
At approximately 9:06 a.m., Train 1 experienced an undesired emergency brake application at MP 685.7. The train had derailed 24 freight cars of various car types, representing lines 18-41 from the head-end, at approximately MP 686.5, station Jericho, on the UP Lynndyl Subdivision. The derailment occurred in a remote area of Juab County, Utah, approximately 20 miles east of Lynndyl. At the time of the derailment, the train was traversing a 0.80-percent downhill grade on tangent track with the PTC system cut in, in moderate dynamic brake, maintaining 35 mph. The maximum speed for this train was 50 mph. The crew called the dispatcher and told him that they were in emergency and the conductor was going to walk the train. The conductor could smell the escaping propane gas vapor. He then notified the engineer of the

situation, who then notified the dispatcher that their train had derailed and that they had a car leaking hazardous materials. At that time, the engineer also told the dispatcher that several other propane cars were in that portion of the train and used the DPU screen to shut down the DPU locomotives so they would not be a source of ignition. The conductor returned to the lead locomotives and applied the handbrakes to the portion of the train that they were still coupled to. He then made a cut and the crew took the locomotives farther west to get away from the derailed and leaking cars. The derailed cars were lines 18-43 from the head-end, of which 12 contained hazardous materials.
The Juab County Sheriff's Department arrived and set up a command post. Local fire and EMS units from the surrounding area also responded to the scene. Non-essential personnel were kept at least 1.5 miles away from the derailment due to the leaking propane car. No evacuations were ordered due to the remote location. UP staged work trains east and west of the derailment site. The following day, March 31, 2019, a contractor was brought in from Baton Rouge, Louisiana, to perform a vent and burn of the nine propane cars and two cars containing bio-diesel. They were rigged with explosive charges and detonated at 9:30 p.m.

Approximately 600 feet of mainline track and 600 feet of siding track were torn up along with another 600 feet of mainline rail rolled over, requiring 32 track panels to repair. Also, the power switch at MP 692.7 was damaged and minor damage sustained on the ties between MP 696.7 to MP 686.5, representing the initial point of derailment to the derailment site.

The damage estimates are as follows: track $413,316; signal: $226,842; and equipment: $1,502,035. All cars were scrapped on site.

Post-Accident Investigation
Federal Railroad Administration (FRA) investigators conducted interviews with crewmembers of both the inbound Short Pool crew and outbound Long Pool crew. The mechanical foreman and the yardmaster at Roper Yard declined to be interviewed due to the pending railroad investigation. Photographs of the derailment scene were taken to document the damage and array of the derailed cars, as well as mechanical and equipment evidence. The investigators secured and analyzed the signal and train control downloads, track inspection records, equipment downloads and records, dispatcher recordings and the training, testing and certification records of the personnel involved. The investigators were told the first car to derail, AOK 6401, a flatcar loaded with railcar wheel sets at position 18 of the consist, was dragged off the rail. They were told the car had been re-railed and moved prior to their arrival so no photographs or representation of the car on an accident sketch was possible.

Post-accident interviews with both train crews involved led the investigation to a defect with car MP 650466, the 19th car from the head-end. Equipment records show a history of airbrake issues with this car. Signal and Train Control downloads support that there were indications of brake system issues causing elevated temperatures of wheels on that car. An eyewitness report from a crew performing a roll-by inspection of Train 1 reported that sparks were coming off a car, which a walking inspection from the Short Pool conductor of Train 1 confirmed was car MP 650466. Evidence at the derailment site of the

wheel sets belonging to the car showed excessive tread build up as the result of sliding wheels.

Although the car was identified as defective by the Short Pool crew, no repairs were made or corrective action taken on it and the Long Pool crew continued with the car remaining in Train 1. The investigation revealed the car initially derailed at MP 696.7, between Stations Tintic and McIntyre, and was dragged 10.9 miles before the train went into undesired emergency and derailed into a general pile-up at MP 686.5 near Station Jericho.

The post-accident investigation revealed the car foreman never looked at the car in question. He told the on-duty yardmaster that he could not get to the car from the train's current location and asked what the crew had found. The Roper yardmaster stated he didn't know what the crew had found, and the car foreman then advised if they needed to inspect it, they could do it at Garfield, located 16 miles to the west of North Yard, and let mechanical forces know. The investigation revealed the crew did not find the cause of the hot wheels and, after being instructed by the Roper yardmaster to continue to the crew change location, the crew assumed the issue with the car was resolved.

Analysis and Conclusions

Analysis – Communications: A roll-by inspection of Train 1 was performed by a crew of a train on an adjacent track, and this crew informed the Roper yardmaster that Train 1 had a car with sparking wheels and gave a car type and approximate location. After the Roper yardmaster notified the crew of Train 1 about this report, the crew stopped their train and the conductor performed a walking inspection and identified car MP 650466 as having wheels radiating heat. The conductor found no handbrake on the car which could have caused the wheels to slide and spark. He attempted to troubleshoot the air brake system on the car with inconclusive results, as he could not determine what caused the wheels to get hot.

Approximately one hour after stopping and inspecting the train, the crew of Train 1 was given a signal and instructed by the train dispatcher to proceed to the crew change location at Salt Lake City Intermodal Terminal (SLCIT). Post-accident interviews revealed that the Short Pool crew did not question what was done about the car and assumed the car was OK since they were instructed to continue with the train. Post-accident interviews revealed the Long Pool crew knew that the inbound train experienced a delay because the conductor had to inspect the train due to a report of a car with sparking wheels. However, during the crew swap at the SLCIT, there was only a brief mention of the sparking car, and the Long Pool crew assumed that since the Short Pool Conductor noted the brake shoes were releasing, there was no further action to communicate to the Long Pool Crew.

Communication failures occurred multiple times. The Mechanical Foreman decided to not inspect the train because he could not easily access the car. He informed the yardmaster that, if an inspection would still be required, it could be done at Garfield, and directed the yardmaster to let mechanical forces know when to meet the train. It is unclear why the yardmaster instructed the train crew they could proceed to the crew change location. This led the Short Pool Crew to believe the issues with the car had been

resolved. This was evidenced by the Engineer's statement that yardmaster called them on the radio, and stated, "You're good to go and proceed to the crew change point."

Conclusion – Communications: FRA determined the breakdown in communication, and lack of action taken by the Yardmaster and Car Foreman contributed to the derailment. (Cause code H995 and H999)

Analysis - Operating Practices/Train Handling: A review of the lead locomotive event recorder download showed that Train 1 was in dynamic brake traveling at 36 mph on a descending grade of 0.80-percent when it experienced an undesired emergency brake application. The maximum time table speed for this territory is 60 mph. FRA did not take any exceptions to how the train was being operated.

An inspection of Train 1's crew records revealed all training, testing, certification and hours of service (HOS) requirements in compliance.
Conclusion – Operating Practices/Train Handling: FRA determined operating practices/train handling did not contribute to the cause or severity of the derailment.

Analysis – Track: Track is described as 133 lbs. rail on wood ties. A post-accident site inspection was conducted and no defects were noted. This segment of track is inspected twice weekly by UP and no defective conditions were noted on or near the area of the point of derailment on the most recent track inspection performed March 27 prior to the derailment. Internal rail defect testing was performed on this segment of track on October 23, 2018, with no defective conditions found on or near the area of the point of derailment.

Conclusion – Track: FRA determined the track did not contribute to the cause or severity of the derailment.

Analysis - Signal and Train Control (S&TC): A review of the UP-Dispatch Center's Computer Aided Dispatching (CAD) log shows a normal move for Train 1 going westbound up to the point of the derailment. CAD log shows prior to Train 1 going into emergency at MP 687.7, the power switch machine at CPC693 East McIntyre went out of correspondence as the train passed over it at 8:55:50. The CAD also showed the track circuit section through the switch stayed occupied after Train 1 had left that section of track. The CAD log shows a normal move at CP C691 West McIntyre at 8:56:58. At 9:06:43, the CAD log shows the power switch at CPC686 East Jericho going out of correspondence and both the main line and siding track circuits occupied due to the derailment.

The Dispatcher CAD log showed East McIntyre out of correspondence; the track OS section at McIntyre stayed down after the train had cleared that section, and the switch at CP C686 East Jericho out of correspondence support that car MP 650466 derailed at MP 696.5 and was dragged 10.9 miles. It also damaged the power switch at McIntyre and eventually derailed the train at the switch at East Jericho, MP 686.06. All Signal and Train Control systems were working as intended and did not contribute to the cause or severity of the derailment.

Conclusion – Signal and Train Control (S&TC): FRA determined Signal and Train Control did not contribute to the cause or severity of the derailment.

Analysis - Hot Box/Hot Wheel Detectors: Train 1 passed over seven hot box detectors (HBD) between Ogden and the initial point of derailment at MP 696.7. Four of the seven HBDs are equipped with hot wheel detector (HWD) scanners. Downloads show that on all four HWDs, the car with the highest wheel temperatures was car MP 650466; however, the temperatures did not reach the 900 °F above ambient necessary to trigger an alarm.

A review of all records indicates the hot box detectors and hot wheel detectors along this route to the point of derailment functioned as intended and are excluded as having contributed to the accident. Although hot wheel scanners noted elevated temperatures on car MP 650466, these temperatures did not reach the point of alarm notification prior to the derailment.

Conclusion – Hot Box/Hot Wheel Detectors: FRA determined the defect detectors did not contribute to the cause or severity of the derailment.

Analysis – Motive Power and Equipment (MP&E): Train 1 originated at Ogden, on March 29, 2019, as a manifest train; the locomotives received a daily inspection before departing. Because the train was long; it was split onto two tracks. Cars on each track received a Class I Air Brake Test, and a pre-departure inspection by qualified mechanical inspectors at approximately 8 p.m. A visual roll-out was conducted by two carmen on each side of the train. They noted no defects and observed no sparking as the train rolled by.

The investigation focused on freight car MP 650466, an open top gondola. Its placement in the train was the 19th car from the lead locomotives of Train 1; it was this car that was observed by the crew of a train on an adjacent track at the UP North Yard. Four wheel sets were found at the derailment site and believed to be from the MP 650466. Three of the wheel sets had excessive tread build up and eight inch flat spots. This car had a history of wheels trending hot going back at least one year.

The railroad has defect detectors in place that measure wheel and bearing temperatures on passing trains, and are used to identify mechanical defects. When hot wheels are reported, they are repaired by the mechanical department as needed. Hot wheel detectors are set between 800 °F and 900 °F above ambient temperature. UP's T2 Desk, the department responsible for monitoring the detectors, determines how each alert is reported. The T2 Desk assesses each alert which must trigger three consecutive times per event and considering weather, terrain, weight of the car, and car history before a call is made for further investigation. Cars are pulled out of service if alerted by the hot wheel detectors three times. The T2 Desk will initiate an inspection of the wheels to determine if it needs to be sent to a repair shop for inspection and/or repairs.

Documentation from at least 2008 showed car MP 650466 had hot wheels and air brake issues reported.

The car triggered hot wheel detectors on several occasions. The railroad followed the necessary procedures to inspect and repair these kinds of defects. Several single car air brake tests per AAR rule 3, S-486 were conducted and no defects were noted. Wheels were also changed out on March 3, 2017, and all required inspections and air brake tests were again performed.

FRA MP&E and UP mechanical department personnel inspected records and performed field investigations of the locomotives and cars for any contributing factors. The focus was placed on car MP 650466, the 19th car from the head-end of the train; this car was observed to be sparking and had hot wheels in the UP North Yard.

FRA determined tread build up and flat spots, observed during the post-accident investigation, resulted from a defective brake valve that caused the brakes to apply and stick, and that car MP 650466 derailed after the brakes became stuck. The suspected brake valve for the car was sheared off, along with the brake rigging, during the derailment and could not be located.

Conclusion – Motive Power and Equipment (MP&E): FRA concluded the mechanical condition of MP 650466 was the cause of the derailment. (cause code E06C)

Analysis – Fatigue: FRA uses a threshold value of 72 as the baseline for fatigue analysis. This value is based on the validation and calibration of the Fatigue Audit InterDyne (FAID) model and indicates the level where the risk of a human factor accident is less than or equal to chance. Schedules that violate the established threshold for 20 percent or more of the on-duty time are at an increased risk of fatigue contributing to an accident. If an employee does not provide sleep information, FRA uses the default software settings.

FRA collected a 10-day work history of the Short Pool and Long Pool crew members. Although the Short Pool crew was not directly involved in the derailment, they were the crew assigned when sparking car MP 650466 was first discovered.

The Short Pool Engineer and Conductor were both operating with excessive fatigue risk, whereas the FAID data suggests the engineer and the conductor of the Long Pool crew exhibited no fatigue.

Despite these results, FRA determined fatigue was not a factor in the ensuing derailment as the actions of the Short Pool and Long Pool crews did not contribute to the derailment.

Conclusion – Fatigue: FRA determined fatigue did not contribute to the cause or severity of the derailment.

Analysis - Toxicological Testing: This accident met the criteria for Title 49 Code of Federal Regulations (CFR) Part 219, Subpart C, Post Accident Toxicological Testing. The Long Pool train crew were tested under FRA guidelines for the use of alcohol and drugs. The results were negative for all train crew members involved in the derailment.

Conclusion – Toxicology Testing: FRA determined drugs and alcohol did not contribute to the cause or severity of the derailment.

Overall Conclusions

A post-accident review of track, S&TC, training and certification were all excluded as having contributed to the accident.

Following a multi-discipline review of all available information, FRA determined a stuck brake on car MP 650466 caused excessive tread wear, tread buildup, and flat spots on the wheels, which caused the car to derail, cause code E06C, brake valve malfunctions (stuck brake, etc.).

Prior to the derailment, the stuck brake was identified and reported. The short pool crew on the train, the Car Foreman who responded to the report but failed to inspect the car, and the Yardmaster were all aware of the issue, but the car was allowed to continue in the train. The lack of communication between, and action by, the Car Foreman and Yardmaster contributed to the derailment. After the crew change and departure, the stuck brake led to excessive tread buildup on the wheel of MP 650466 causing it to derail. The car was dragged almost 11 miles before causing the rest of the cars to derail in a general pileup. These failures lead FRA to assign human factor contributing cause codes.

Probable Cause and Contributing Factors

FRA determined the probable cause of the derailment was E06C, brake valve malfunction (stuck brake, etc.).

Additionally, contributing causes to the derailment were H995, Human factor - motive power and equipment, and H999, Other train operations/human factors.