NATIONAL TRANSPORTATION SAFETY BOARD

Office of Railroad, Pipeline and Hazardous Materials Investigations
Washington, DC

RAIL FACTUAL REPORT

A. ACCIDENT

NTSB Accident Number:	RRD21LR007
Date of Accident:	January 31, 2021
Time of Accident:	12:40 p.m. (Local)
Railroad Owner and Operator:	Union Pacific Railroad
Maintenance Equipment:	Track Maintenance Tamper-1602
Maintenance of Way Crew:	UP Tie Team- 9062
Fatalities:	1
Injuries:	1
Location of Accident:	Vail, AZ

B. Group Chairs and Party Representation

Joe Gordon
Investigator-in-Charge
National Transportation Safety Board

Michael Hoepf
System Safety Investigator
National Transportation Safety Board

John Manutes
Crashworthiness/Mechanical Investigator
National Transportation Safety Board

Patrick Sharp
Railroad Safety Inspector- FRA IIC
Federal Railroad Administration

Anthony Bernhard
Director of Engineering Safety
Union Pacific Railroad

Roy Morrison
Director of Safety
Brotherhood of Maintenance of Way Employes Division

John Gobert
Regional Service Manager
Nordco Inc.

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C. ACCIDENT SUMMARY

On January 31, 2021, at about 12:40 p.m. local time, a Union Pacific Railroad (UP) employee with 41 years of railroad service was struck by a rail-bound roadway maintenance machine (RMM) known as a track maintenance tamper (TMT) which was tamping wood crossties on a main track near Vail, Arizona.[1] The employee was airlifted to a hospital, where he later died from his injuries. The TMT is one of about 17 pieces of equipment that comprise the UP-Tie Gang 9062.[2] The tie gang was tasked with crosstie renewal and track surfacing.[3] The TMT operator, who had been employed by UP for 27 years and worked as an equipment operator on UP for 13 years, was seated in the machine's cab facing forward. At the time of the accident, the sky was clear, the temperature was 67°F, and the wind was calm. Figure 1 shows an aerial view of the accident location. Figure 2 shows the TMT at the accident scene.

[1] (a) The definition of a roadway maintenance machine can be found in CFR Title 49, Part 214.7- Railroad Workplace Safety- *definitions*. (b) A track maintenance tamper is a machine equipped with hydraulic tools designed to lift individual crossties into proper vertical and horizontal position while vibrating tools pack ballast under the crosstie to ensure it remains in position. (c) Tamping means to pack track ballast under the cross ties to set the track at the proper vertical and horizontal position and make the aggregate more resistant to further compression.
[2] A tie gang is a railroad track maintenance group consisting of a series of rail-mounted machines and employees working in unison to adjust and replace railroad crossties. A UP tie gang may recondition up to 2-miles of crossties per day.
[3] Track surfacing refers to a railroad maintenance operation to raise the track structure and obtain desired track geometry. This work is primarily accomplished using specialized railroad work equipment.

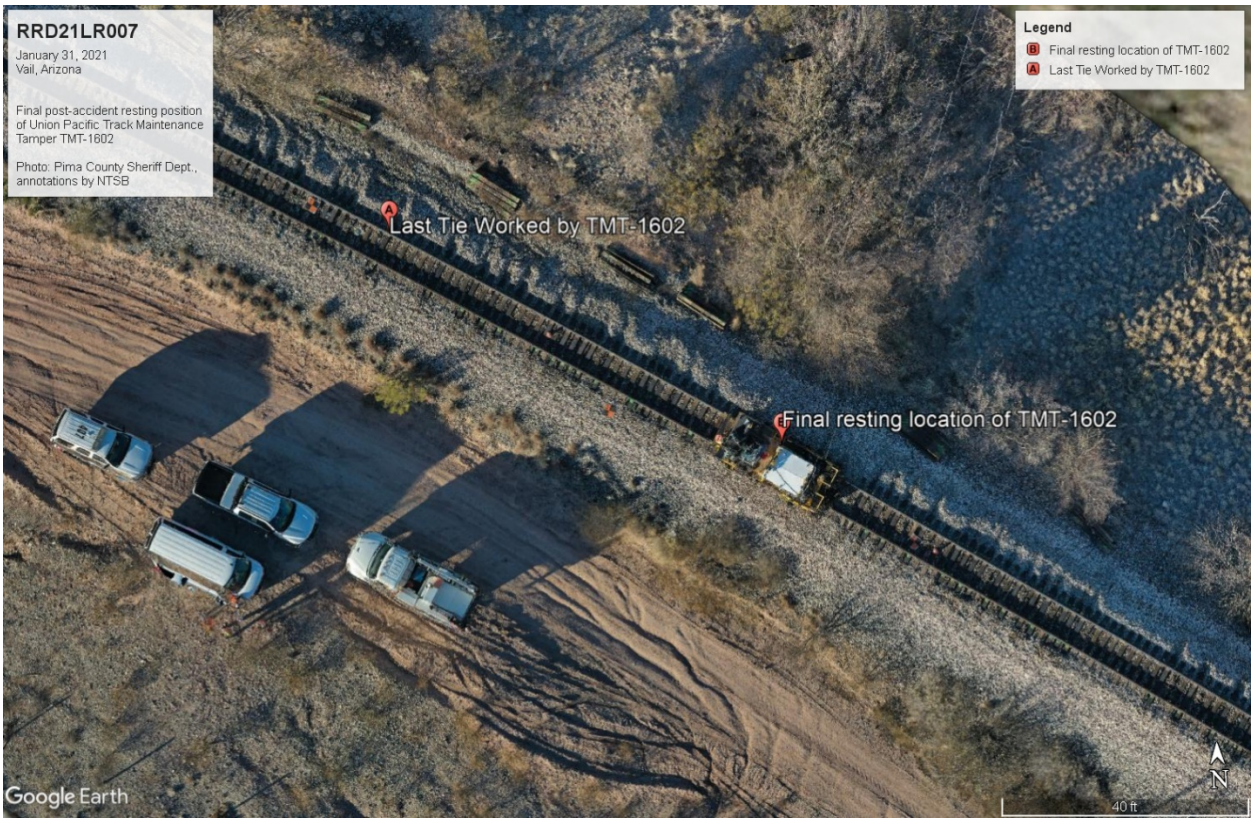

Figure 1. Aerial view of the accident location. (Photo provided by the Pima County Sheriff's Department.

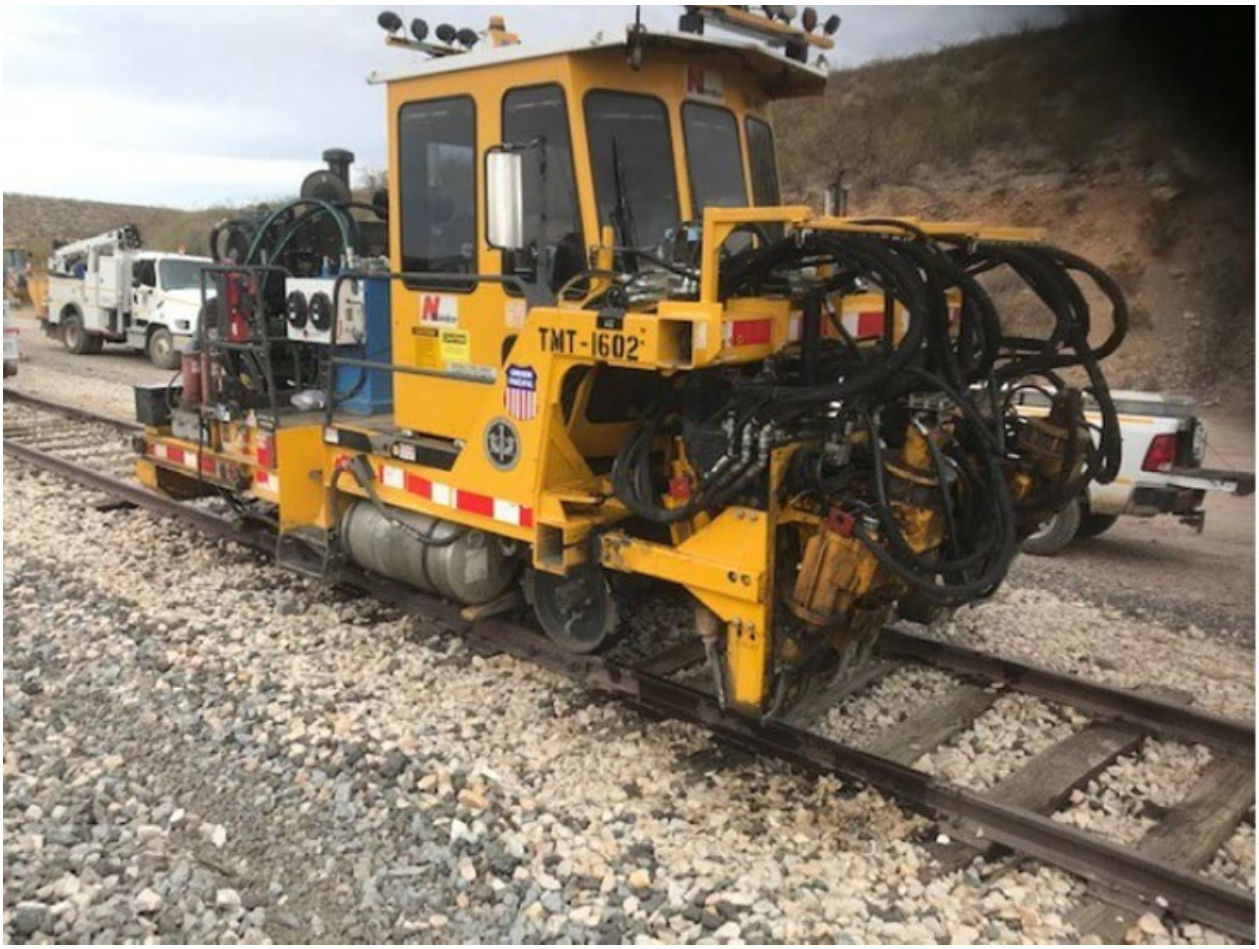

Figure 2 The TMT at the accident scene. (Photograph provided by UP.)

The employee who was struck was inspecting crossties prior to the accident. If a crosstie needed tamping, he marked the center of the crosstie with paint to notify the TMT operator to work at that location. Tamping a crosstie is a mechanical process in which ballast rock is forced under the crosstie to restore uniformity to the track structure. At the time of the accident, the employee was walking between the rails and in front of the TMT. The TMT operator completed tamping a crosstie and began to move forward to the next crosstie to be tamped. He stated that he attempted to stop the equipment at that crosstie, but the TMT continued forward at a speed of about 3-5 mph and struck the employee. The TMT operator also sustained minor injuries in the accident.

D. ACCIDENT DETAILS

Interviewees

Investigators from the NTSB and other parties interviewed the following UP engineering department employees:[4]

- TMT-1602 Operator
- Work Equipment Manager
- Manager of Track Programs
- Roadway Maintenance Mechanic
- Director of Engineering Safety
- Director of Track Programs
- Safety Captain
- Operator of Rail Lift Plate Inserter, operating ahead of TMT-1602
- Track Laborer working behind TMT-1602

The Accident

The following description of the incident is based on the interviews:

The track maintenance tamper was a part of the UP 9062 Tie Gang. The tie gang is a system-production work group that consist of approximately twenty-three RMMs, and 45-50 employees including: machine operators, vehicle operators, and laborers. The task assigned to the team on the day of the accident was to replace worn crossties with new crossties and surface the track structure.[5] This gang's goals is to replace about 1,450 crossties per day. The 9062 Tie Gang

[4] Transcripts of these interviews are available in the public docket.
[5] Track Surfacing refers to a railroad maintenance operation to raise the track structure and obtain desired track

went on duty at about 8:00 a.m. on the day of the accident at a location near milepost 1003.78 of the Lordsburg Subdivision. The workers then traveled approximately 18 minutes by bus to the work location at the Marsh Setout Track, milepost 1012.37. After arriving at the work location, the roadway worker in charge conducted an on-track safety briefing. The method of on track safety was the establishment of working limits through a track authority with the UP-train dispatcher. The working limits were between control point 1000 and control point 1023 on main track one of the Lordsburg subdivision.

Following the job briefing and completion of daily RMM inspections, the operators started to move from the siding where the equipment was parked overnight to the main track to begin the tie renewal work; this movement began at 9:28 a.m. According to the Safety Captain who provided the job briefing, in addition to on-track safety worker safety was discussed; specifically proper equipment spacing per UP rules. The TMT-1602 tamper operator said that the RMMs started to spread out and he moved the tamper to the location to start working. He stated that during the movement to the work location, they were maintaining spacing of 50 to 100 feet between the RMMs. He said that he started tamping new crossties and that the ground worker (marking ties) was ahead of him, and he would "spray the down ties". This was to mark the crossties with paint as an indication to him that those existing crossties need to be tamped in addition to the newly installed crossties. The operator stated that as he was working, he continued to look down, then forward to keep the distance between his equipment and the ground worker.

The work process continued, and the operator estimated that he had tamped between 100 and 150 crossties prior to the accident. He stated that just prior to the accident, he had tamped a

geometry. This work is primarily accomplished using specialized railroad work equipment.

crosstie and was going to skip five crossties to get to the next crosstie that required tamping. He stated "I indexed the machine forward and it seemed like it didn't stop, because I let go of the joystick in going forward position and it seemed like it didn't stop to me. That's when I started panicking". The operator recounted that he tried to activate the horn. However, in his "panic mode" he was not successful in pulling on the horn cable above his head. During post-accident observation, investigators noted that about 15 crossties that would have required tamping had been missed. He could not explain why he did not push the emergency stop button and said that the last time he saw the ground man, he was about 10 feet ahead of the machine. He said that he then pulled the joystick back into work cycle and dropped the tamper work heads. On the sudden stop, the operator fell forward and hit his head and knee on the front windshield of the equipment and sustained minor injuries.

When the tamper work-heads struck the ground with the machine in motion, it created a distinct noise and vibration in the ground. This alerted the operator of the Rail Lift Tie Inserter (RLTI) machine in front of the TMT-1062 and the Track Laborer working on foot behind the TMT-1602 that something significant had happened. According to interviews with these employees, and subsequent measurements from the scene, the tamper had stopped approximately 17-feet behind the RLTI. The injured Track Laborer was seen underneath the tamper. The operator of the RLTI made an emergency radio call and accepted a medical kit from employees working in front of him. The operator of the tamper exited the left side of the machine and walked to the front of the machine. After a moment at the front of the machine, where hydraulic oil hose damage would have been evident, he returned to the cab and shut the machine down. The operator of the RLTI walked back to the tamper on the left side where he noticed the tamper operator standing next to the machine, with his back to the machine and eyes downcast. They did not speak

to each other. The RLTI operator walked around the back of the machine to the opposite side. He found the injured employee facing that direction under the machine, between the rails. The RLTI operator stayed with the injured employee and attempted to comfort him until first responders arrived. At this time, the injured employee stated that he had been "run over" but only complained of minor discomfort due to laying on the ballast. Although the tamper operator stated in his interview that he immediately dismounted the machine and spoke to the injured employee while also calling for emergency assistance, these events were not observed by other employees during the post-accident sequence.

UP Track Maintenance Tamper Operating Instructions

The TMT-1602 has two main modes of operation. Railway Travel mode is used to move the machine any distance without conducing tamping operations. This mode is generally used to travel from holding areas to work areas. Tamping Operation mode, or "Work" mode is used engage the work-head vibrators and cab controls for packing ballast under ties. The modes are selected using switches located on the rear main panel. When the machine is in work mode, a switch located on the right arm control panel allows the operator to select Manual or Automatic tamping operations. Manual operation enables the operator to use the single joystick to move the machine forward by pushing the joystick forward. Releasing the joystick removes propulsion and applies the friction brakes. Pulling the joystick back and holding it there engages one tamping cycle. During a manual tamping cycle, the work-heads lower around a tie, vibrate ballast into place, release the tie, and return to the starting position. In manual mode, the foot-pedal is disabled. If automatic tamping operation is selected, the foot-pedal is enabled. Automatic mode is designed for areas where it is necessary to tamp every tie without skipping any. It is designed to allow the operator to get into a rhythm of pressing and holding the foot-

pedal which completes a tamping cycle and immediately travels the machine forward. Automatic mode is rarely, if ever, used at Union Pacific because there is almost always uneven spacing between the ties that need tamping in surfacing or tie gang work.

Post-Accident Inspection and Testing of TMT-1602

On Monday, February 1, 2021 subject matter experts from Union Pacific and Nordco convened near Vail, Arizona to inspect and test the operation of TMT-1602. The team identified a ruptured work head hydraulic hose. A ruptured hydraulic hose at this location is consistent with the work heads being lowered into the ballast and ties while the machine is in motion. The sudden stop, and resulting pressure surge, is a known failure mode for this hose. The team replaced the hose prior to conducting additional testing to prevent additional hydraulic oil loss. Additionally, the left side step used for boarding the machine had been removed. It was determined that this step was removed to facilitate first responder's access to the injured employee. The step was replaced before further testing was conducted. Finally, the team identified a broken bottom-center window. The broken window is consistent with the operator's statement that he struck his knee on the window during the accident sequence. The window was not replaced.

Documents onboard the tamper were reviewed. The machine was built in 2016 and had 5,332 hours of operation. The previous annual inspection had been completed on March 15, 2020. The daily logbook had been completed on the day of the accident. Entries in the logbook chronicled events relating to the rear hydraulic travel motor. On January 30th the rear travel motor had a leaking hydraulic shaft seal that required the motor to be removed from the machine and replaced. A mechanic replaced the motor with a remanufactured unit that was on-hand. The

replacement motor failed after less than 1-mile of travel. There were no additional motors on-hand. Therefore, the mechanic removed the rear motor drive chain and disengaged the rear motor. On the day of the accident, the logbook entry noted the disconnected rear travel motor.

Next, the team continued the safety inspection by checking fluid levels, starting the machine, and inspecting for proper air pressure and hydraulic pressure. The following additional items were noted; the front travel motor drive chain was out of adjustment and contacting the frame of the machine, however the chain was functional and was not adjusted prior to additional testing. The friction brakes were functional but also out of adjustment, meaning that there was a gap larger than 1/8-inch between the brake shoes and the wheels when the brakes were in the released position. The brakes were not adjusted prior to additional testing. There was a minor hydraulic leak from a travel manifold hose. Finally, the operator's in-cab foot pedal was noted as "inoperative". The foot pedal was later determined to be functioning as designed during subsequent testing.

The team conducted normal operational functions of TMT-1602 for over 2-hours on a siding track. The team noted that the machine functioned normally with no defective conditions noted. Special attention was paid to the hydraulic system pressures at the high-pressure pumps and travel motor cross over relief valves. The pressures were within manufacture specifications and the system was operating normally.

On Tuesday, February 2, 2021 the team reconvened to conduct structured testing to simulate the accident conditions. The machine was moved onto the Lordsburg Subdivision main track near mile post 1012.5. At this location the rail profile is identical to the accident location. The grade is an ascending 0.73% which is more conservative than the accident location's 0.97% grade.

Braking tests were conducted to determine the condition of the machine under normal stopping conditions. The machine was placed in work mode and accelerated to its maximum work speed of 9 mph. In one test, the emergency stop button was then pressed. The machine stopped after 23-feet. The test was repeated, and braking was accomplished by simply removing pressure from the joystick to simulate the normal stopping procedure. The machine stopped after 21-feet.

Braking tests were also conducted in Travel Mode to determine the maximum speed and worst-case braking distances. In Low Travel Mode a top speed of 14 mph was accomplished in approximately 660-feet. After traveling an additional 660-feet at 14 mph, a normal stop was accomplished by releasing the joystick. The machine stopped after 55-feet. In High Travel Mode a top speed of 17 mph was accomplished in approximately 660-feet. After traveling an additional 660-feet at 17 mph, a normal stop was accomplished by releasing the joystick. The machine stopped after 59-feet.

Time and distance tests were conducted to simulate the accident scenario. The machine was operated from a standstill at a location designated as “Tie 0”. Tie 0 simulates the location of the last tie the tamper worked prior to the accident. The machine was operated forward. It reached “Tie 5” after 3.35 seconds. The distance to Tie 5 was 9 feet. Tie 5 represents the next tie that was to be tamped but was not tamped in the accident sequence. Operation of the machine continued to the simulated point of impact. This location is 64-feet from Tie 0. The machine reached the impact point 12.86 seconds after beginning at Tie 0. It was noted that the machine traversed the 55-feet between Tie 5 and the impact point in 9.33 seconds. This test was repeated but instead of continuing, the Emergency Stop Button was pressed at Tie 5. The machine

stopped 11-feet beyond Tie 5.

The UP moved TMT-1602 to the system maintenance facility in Denver, Colorado at the request of NTSB. The movement was completed using UP chain of custody protocols. The machine was lifted onto a flatbed highway trailer and placed at a secure location within the maintenance facility.

On March 24, 2021 the Mechanical Technical Working group convened in Denver to conduct additional testing. The technical working group consisted of investigators from NTSB, FRA, UP, BMWED, and Nordco.

The working group first conducted a routine inspection of TMT-1602. The group noted that the indicator light panel for the two high pressure filters displayed inconsistent indications. The number 1 high-pressure hydraulic filter indicator lights were not illuminated. Normally, either "clean" or "bypass" should be lit. Also, the number 2 high-pressure hydraulic filter indicator light for "bypass" was lit, which could indicate a blockage in the filter.

As noted in the prior testing, the friction brakes needed adjustment. Although the brake pads were farther from the wheels than the standard prescribes, it was noted that prior brake testing had already been conducted and the brakes were known to function. Therefore, no repairs were made prior to additional testing.

The front travel chain was riding on the vehicle frame, as previously noted. The rear travel chain was removed, also as previously noted. No repairs were made prior to additional testing.

All switches, electrical cabinets, connectors, and wiring were inspected. The cabinets were clean and free from debris and corrosion. The switches and connectors were secure. No

damage to any wiring or electrical component was noted.

The group referenced on-scene photographs provided by first responders from the Pima County Sheriff's Department to position the sunshades in the operating cab as they were at the time of the accident. Sight-distance observations were made by positioning a person 75-feet in front of the machine, and 6-feet left and right of the track at that distance. The person was then asked to walk toward the machine at 5-foot increments until he touched the machine. There were no obstructions or blind spots that would block the view of the operator, the person was visible at all locations.

The group conducted dynamic tests by first referencing the on-scene photographs to configure the operational switches to the position they were in at the time of the accident. Therefore, the main panel had Work Mode selected and the right-side panel had Manual Mode selected. The first test was a recreation of the intended operation at the time of the accident. Starting from a standstill, a tie was tamped, the machine was moved ahead 5 ties, where the machine was stopped in preparation to tamp that tie. This test was conducted successfully with no abnormalities noted.

The group then conducted investigative dynamic tests that were not within the scope of the known conditions at the time of the accident but could provide some insight as to the functionality of the machine or possible operational conditions that could change the behavior of the machine.

First, the horn was operated by pulling normally on the activation cable. The horn functioned normally and was noted to be within reach of the operator's normal operating position.

The machine was operated in Manual Work Mode, using the joystick to propel the

machine forward and the foot-pedal was depressed. The joystick was released to observe the operation of the machine with the foot-pedal depressed. The machine came to a normal stop immediately after releasing the joystick.

The machine was operated in Manual Work Mode by moving forward with the joystick and switching to Travel Mode. There were no noticeable differences in the machine operation and the machine came to a normal stop when the joystick was released.

The machine was operated in Manual Work Mode a distance of 9 feet and three different stopping modes were tested. The service brake stopped the machine within 5-feet. The parking brake stopped the machine after 5-feet. The emergency stop button stopped the machine after 2.5-feet.

The group attempted to move the machine from a standstill with the service brake applied. The group also attempted to move the machine from a standstill with the parking brake applied. The propulsion motors could not overcome the friction brakes, and the machine remained at a standstill.

The group observed the onboard logic controller and noted that it was free from damage and appeared to be in working order. The delay between the joystick release command and a brake application was programed to 0.2 seconds, as set from the factory when the machine was new. The service brake application valve was also observed to be free from damage and in working order.

Several tests were conducted to determine the operating status of the foot pedal. While the initial observations in Arizona noted that the foot-pedal was inoperative, the working group determined this was inaccurate. The foot-pedal functioned as designed in accordance with the table below.

	Auto	**Manual**
		
Work 	Foot pedal cycles the work heads down, vibrates the ballast, raises the work heads, and travels the vehicle forward until the pedal is released.	Foot pedal does not function, by design
Travel 	Foot pedal moves the vehicle in the direction indicated by the [Forward/Reverse] switch regardless of the Index Select Switch Position 	

After dynamic testing was complete, the group returned to investigate the hydraulic system and indication lights for the high-pressure filters. The number 2 pressure differential sensor was replaced, with no effect. The high-pressure filters were removed and inspected. The filters were observed to be clean and free from debris or any blockage. The condition of the filters and condition of the lights is consistent with a defective indicator light panel, or a pressure difference created by the UP's use of filters that are designed to filter out smaller debris than Nordco originally designed the machine with. UP uses 5- micron filters and the machine was built with 10 micron filters. The working group agreed to conduct a laboratory analysis of the oil and took three separate samples from the hydraulic oil tank. One near the top of the tank, one at the middle, and one at the bottom of the tank. The third-party oil analysis report stated the oil condition was "normal".

Equipment

On the day of the accident Tie Gang 9062 was working in an east direction; the tie team accounted for 17 of the total production team's 23 roadway maintenance machines. The working order of the 9062-roadway maintenance equipment was as follows:

Order of Equipment and Placement of Ground Workers	
Ballast Regulator	
	Ground Worker – marking ties for removal
Crosstie Crane	
Crosstie Crane	
Spike Puller	
Spike Puller	
Crosstie Extractor	
	2 Ground Workers – Removing crosstie plates
Crosstie Crane	
Anchor Spreader	
Scaffire – Cribber	
Crosstie Crane	
Crosstie Inserter	
	3 Ground Workers – 1 cleaning ballast from crosstie, 2 replacing crosstie plates
Rail Lifter Plate Inserter	
	Ground Worker – Marking crosstie for tamping
Tamper	
	2 Ground Workers – Straightening crosstie plates
Spiker/Gauger	
Spiker/Gauger	
Rail Anchor Squeezer	
	2 Ground Workers – installing anchors
Ballast Regulator	

Track Description

The UP Lordsburg subdivision consists of about 311 miles of double track between milepost 1298.5 and milepost 987.7. The double main track is separated by grade in some locations, including the accident location- milepost 1015.55. At the accident location the track grade for the direction of tie-team's direction of travel is +0.97%. Based on the most recent compiled data (2019) the subdivision's average daily train count is about 82 in the area of the accident. According to UP, the estimated total tonnage figure for the incident site is about 104 million gross tons.

UP inspects and maintains the main track on this portion of the Lordsburg Subdivision to Federal Railroad Administration (FRA) Track Safety Standards (TSS) for Class 5 track, which allows for a maximum operating speed of 80 mph for freight trains and 90 mph for passenger trains: UP limits trains to 70 mph. Amtrak operates one "Sunset Limited" passenger train per day on this route, no passenger trains operate on Wednesdays.

Operating Rules

Operating Rules Language

Source document: "cons_engr_rules"

136.3.1: Job Briefing for Roadway Work Groups

The EIC must conduct a job briefing that includes all information related to On-Track Safety. Nothing prohibits the EIC from establishing OTS on one or more adjacent tracks if he or she deems necessary based on the job briefing discussion concerning the work to be performed and characteristics of the work location. This job briefing is given to every roadway worker who will foul the track. In addition to other safety issues, the minimum On-Track Safety information must include:

- Designated EIC
- **Note: When track authorities overlap, the employees in charge of the respective working limits must ensure that working limits within those authorities do not overlap. When multiple work groups occupy the same working limits, only one EIC is permitted and that EIC shall authorize all movements into those working limits.**
- Type of On-Track Safety provided
- Track limits and time limits of track authority
- Identification of any on-track equipment that will foul an adjacent or occupied track
- Nature of work to be performed and characteristics of work location
- Track(s) that may be fouled
- On-Track Safety provided on adjacent tracks, if any
- Procedure to arrange for On-Track Safety on other tracks, if necessary
- Method of warning when On-Track Safety is provided by a lookout

- Designated place of safety where workers clear for trains
- Designated work zone around machines
- Safe working/traveling distance between machines
- Designated equipment work mode and travel mode operations
- Proper procedures for stopping equipment when traveling

The EIC must give a follow-up job briefing whenever:

- Working conditions or procedures change
- Other workers enter the working limits

or

- On-Track Safety is changed, extended, or about to be released

Refer to the current timetable for additional job briefing guidelines.

Rule Updated Date May 2, 2016

136.7.3: Work Zone Around Machines

A. Roadway Workers

Roadway workers must not enter a machine's work zone without first communicating with the operator to establish safe work procedures.

Unless a different work zone is established in the job briefing, the work zone extends from a point 15 feet in front of the machine to a point 15 feet behind the machine.

Note: Some machines, such as cranes and ballast regulators, also require lateral or side clearance to ensure the safety of all roadway workers.

B. Roadway Machine Operators

Roadway machine operators must follow these requirements when operating around roadway workers:

1. If your machine is equipped with a horn or back-up alarm, sound the horn (3 short blasts) or ensure the alarm is sounding before making a reverse move.
2. If you must make a move of more than 15 feet (or other work zone distance specified in job briefing), make sure the way is clear before making the move.
3. Do not approach closer than 15 feet to any roadway worker fouling the track without first communicating with the roadway worker.

Rule Updated Date May 2, 2016

136.7.4: Safe Working Distance Between Machines

Unless a different distance is specified in the job briefing, keep at least 50 feet between roadway machines while working. Equipment is considered to be working when equipment is not prepared for travel as required by the operator's manual. Speed in work mode must NOT exceed 10 MPH.

NOTE: On-track equipment used for snow removal operations from the track structure such as Kershaw or Pike ballast regulators and other snow fighters must not exceed 25 mph while removing snow.

Rule Updated Date May 2, 2016

136.7.5: Safe Traveling Distance Between Machines

Keep at least 300 feet behind other on-track equipment, trains or engines while traveling (see Rule 42.8 Following Cars or Trains).

Equipment is considered to be traveling when equipment is prepared for travel as required by the operator's manual (e.g., work-heads pinned up) and equipment is in "travel" mode, if equipped. Hy-rail inspection vehicles, rail detector cars, track evaluation cars and spray trucks are considered to be in travel mode while they are inspecting, testing and spraying. Operator must not exceed speeds specified in M/W Rule 42.2 "Maximum Speeds" and is further limited to 20 MPH within working limits under conditions specified in 136.7.2(2).

EXCEPTION: When roadway machines need to "bunch up" to move over highway or rail crossings, keep at least 50 feet between the machines.

When slowing down or stopping, comply with Rule 42.9 (Signal to Stop).

Rule Updated Date May 2, 2016

42.2.2: Other Speed Requirements

- Track cars and machines must be operated at a speed that will allow the operator to stop in ½ the distance the track is seen to be clear.
- Where maximum freight train speed is lower, it will govern.
- Reduce speed on curves and branch lines as conditions require and when hy-railing at night.
- When it is raining, or when the rail is wet, only essential hy-rail vehicles are permitted on the track. All other hy-rail vehicles must leave the track as soon as possible.

Operators must take into consideration that a greater distance is required to stop a track car under these conditions.

- When approaching workmen or others on or near the track, reduce speed and, if necessary, stop.

Rule Updated Date

December 18, 2019

System Special Instructions

Effective Date: April 1, 2020

Operating Rules Interview Discussion

Investigators discussed operating rules with the Director of Engineering Safety and Director of Track Programs. The two agreed that the roadway workers and the roadway machine operators shared responsibility for maintaining safe working distance from each other. The Director of Track Programs emphasized the responsibility of the equipment operators to be prepared to stop across all situations. He said: "*the big rule is I'm going to operate my machine, prepared to stop one half the distance the track is seen be clear. Whether I'm in work mode, travel mode, or any mode, I have to operate my machine at a speed that where I can safely stop at one half the rate the track is seen to be clear. Whether I'm in work mode or travel mode*." The Director of Engineering Safety said that this was "Rule 42.2.2," titled "Other Speed Requirements."
The Director of Track programs also said that roadway workers have responsibility to remain alert for a train or equipment "at any time in any direction." The Director of Engineering Safety added that although roadway workers may be engaged in their primary task, they "still need to be cognizant that there is a potential of movement in any direction."

The interview discussion also covered Job Safety Analysis. The Director of Track Programs indicated that UP conducted analysis specifically focused on surfacing gang equipment, which resulted in them "realizing regulators and our tampers were running into each other more than any other piece of equipment we had." He indicated that they observed that certain machines could "run faster" and were involved in more collisions, and thus they "increased the working distance" as well as the "traveling distance of them to mitigate some of that risk that we were seeing out there."

The interview also included discussion of the job briefing. The Director of Track Programs indicated that during the job briefing on the morning of the accident, a safety directive was given such that the minimum distance between the tamper and persons on the ground was to be at least 70 feet. He indicated that such directives were typically documented in a "job briefing book."

Investigators also spoke with the Safety Captain, who led the job briefing on the morning of the accident. He said that he "really stressed the workspace, the 25 between personnel to equipment, 50 from machine to machine, 70 rail to pup tamper…" He indicated that the additional distance required around the pup tamper was because of the operator's limited visibility looking out the windows. For instance, he said that the rear motor of the tamper obstructed visibility during reverse movements. He indicated that the additional clearance around the pup tamper was a safety enhancement that was broadly used "every day" by "every one of our tie gangs."

The Safety Captain described a recent incident that had occurred wherein several machines were traveling along a track and one accidently impacted another. He said the operator did not hear the equipment in front of him stopping. He indicated that the accident was particularly concerning because a person on the ground was nearly impacted from the secondary movement of the machine that had been rear-ended. He indicated that since the accident (which he believed occurred in October or November of 2020), there had been an increased emphasis on maintaining safe distances between persons and equipment with the intention of preventing a similar accident.

Job Safety Analysis

Source document: "PB-20416 Operating On-Track Equipment Job Safety Analysis (JSA)_rev.082018"

- *Job Title/Operation:* OPERATING ON-TRACK EQUIPMENT (OTE)
- *Supervising Position:* Engineering Department Managers
- *Date:* October 5, 2009 [Revised 08/20/18]
- *Craft/Job Position:* Track and Bridge Employees
- *Department:* Engineering
- *Facility/Location:* On-Track
- *Sequence of Basic Job Steps:* Working equipment
- *Potential Hazards, Acts or Conditions:* Collision with other OTE while in work mode
- *Required Actions or Procedures (New actions or procedures are underlined.):* Keep at least 50 feet between OTE while working unless a different distance is specified in the job briefing. Certain situations may necessitate the bunching of equipment closer than 50 feet (working into or out of CP's, working into and out of ends of yard tracks, hooking tow bars, etc…) Enhanced job briefing must be conducted to specify all moves to be made and working distance. Working distance for surfacing gang equipment is a minimum of 150 feet – no exceptions for bunching or working.

Tamper Operator Work History, Qualifications, and Training

Work History

Source document: Tamper Operator Work History

Last Hire Date: 3/29/1993

Years of Service: 27

Position Title: System Pup Tamper Operator

Union: 02: BMWED

Training records show that Tamper Operator had completed a wide variety of training courses over his decades of working experience, including, but not limited to the following topics:

- On Track Safety
- Personal Protective Equipment
- Lockout Tagout
- Reduce Slip, Trip, and Fall
- Hazard Communication
- Basic Medical First Aid/CPR
- Emergency Response
- Hazardous Materials
- Respiratory Protection
- Hearing Conservation
- Fire Prevention

- Fire Extinguishing
- Heat Stress
- Locomotive Cab Safety
- Working in Grade Crossing
- Confined Space Entry
- Fall Protection
- Crane Safety
- Asbestos Awareness
- Bridge Worker Safety
- Tunnel Safety
- Rail Security Awareness

The Tamper Operator had two incidents in his discipline history:

- A 1/9/2018 described as: "Critical Rule violation. Observed employee going down main line with employee in equipment on cell phone. He was the operator. equipment was moving!"
- A 10/13/2015 incident described as: "Coaching. Operator responsibilities, drive shaft on stabilizer was missing 2 bolts all other drive shaft bolts were loose, also operator left batteries on, machine had to be jumped again. talked with employee on his responsibilities of doing a good walk around his equipment every morning filling out hid daily log book"

Source document: Tamper Operator Interview

The Tamper Operator told investigators that upon being hired in 1993, he started as a laborer running small machines. He said that he did this for about three years, and then in January 1996, he progressed to a track machine operator, which requires the operation of larger machines, such as tampers and regulators. He said that the first track machine that he operated was a 6700 Jackson Tamper, and then he proceeded to operate a variety of different machines. He said that he had worked on both small and large gangs.

The Tamper Operator described his recent employment:

"May of 2020 is when I got back on a gang. Got back on 90 -- well, actually, 8566 gang. I worked there one half and then I took vacation, and then that's when I caught the COVID and I was hospitalized June -- May 31st all the way to June the 12th. As I was hospitalized, I fought with COVID-19. And then I didn't -- I took four months off, finally get my doctor's release from

Gallup (ph.) and then my doctor's release from the UP. So, I went back to the railroad. My doctor from Gallup, she released me on September 19th to go back to work, and then the UP finally released me and I came back -- October the 6th was my first day of work back, and I went back on the TKO that I was running, and I finished that out and -- until we got (indiscernible) -- till we got cut off, and then I went to another gang on a TKO again in Steamboat Springs, Colorado. Then we moved to Green River, Wyoming. I stayed there until I caught a bit on the backhoe. And prior to this, I was running a backhoe for four days, and then I got bumped. And then, after that, I bumped on the machine that I was running right now, the pup tamp."

Operational Testing

Source document: Tamper Operator Testing History

Between January 2019 – January 2021, the Tamper Operator had 44 efficiency tests. Of these, he passed 31, and 13 resulted in a rules review. Rules reviewed included:

- Comply with Instructions (2/19/2019)
- Precautions Against Slips, Trips, and Falls (3/6/2019 & 11/24/2019)
- Personal Protective Equipment (8/24/2019)
- Hard Hats (8/24/2019)
- Operators (8/26/2019 & 1/15/2020)
- Rules, Regulations and Instructions (8/26/2019)
- Job Briefing (12/5/2019)
- Operating and Working Near Roadway Machines (12/6/2019)
- Signal to Stop (2/27/2020)
- Standing Equipment (March 29, 2020)

Qualifications

Source document: "Machine Operator Qualification Dates"

The Tamper Operator was qualified to operate the 'Tamper Pup Harsco' effective 11/20/2002. He was also qualified to operate several other types of equipment, including a ballast regulator and a backhoe.

Work Schedule

Source document: "Gang details"

UP records reveal the work schedule for the 'Gang: 9062.' According to UP, 'Permit Hours' indicates time spent actively engaged in track work, whereas "Total Work Hours' indicates the hours that employees were paid in total. Recall that the accident occurred on January 31, 2021 about 12:40 p.m.

Date	Permit Hours	Total Hours Worked
1/3/2021	9.37	11.5
1/4/2021	9.33	10.5
1/5/2021	10.48	11.48
1/12/2021	9.42	10.5
1/13/2021	7.98	11.27
11/14/2021	6.53	10.5
1/15/2021	7.73	10.5
1/16/2021	9.05	10.5
1/17/2021	9	10.7
1/18/2021	7.38	10.5
1/26/2021	8.53	10.5
1/27/2021	6.72	10.5
1/28/2021	9.47	10.87
1/29/2021	6.42	10.5
1/30/2021	9.33	10.5
1/31/2021	11.23	12.87

Source document: Tamper Operator Interview

In the days leading up to the incident, the Tamper Operator said that he had enough good quality sleep at a hotel located about 15 miles from the work site. He said that he typically went to bed between 9:30 – 10:00 p.m. and his alarm was set for 6:00 a.m. He said that in the morning, he generally drank coffee around 6:30 a.m., and departed for the work site about 6:45 a.m. He indicated that he was "energized" and "ready to go" by the time work started at 8:00 a.m.

Cellular Phone

UP representatives verified that the machine operators' cellular phone was not on his person on the day of the accident. In his interview the operator stated that he did not have his cellular phone in the cab of the tamper. UP policy prohibits the use of cellular devices while operating equipment or fouling railroad tracks.

E. UP Response to the Accident

In response to the accident, UP initiated an operational testing plan focused on additional stop-distance testing of equipment operators. This increased testing is planned to begin in March and continue through May of this year. Each month there will be emphasis on a different aspect of equipment operational safety. UP characterized the testing as follows:

> In an effort to prevent on track equipment collisions, various work groups have put together a 3-month plan for all work groups that have on track equipment. Our focus needs to be centered around on track equipment (non hy-rails) when they are traveling to and from the work site. Please review the following plan by month.
>
> - **March- Stop Distance Exercise:** This will be performed on all equipment for the month of March. It ensures the operator knows how to stop their machine and most importantly shows that the stop distance varies so leave themselves more room. This will touch all operators. During this contact they will verify everyone understands the process for coming to a stop.
> - **April- Structured Stop Test:** Test to ensure operators are traveling prepared to stop. This will touch various operators.

- **May- Equipment Signal to Stop Test:** Test the equipment operators' knowledge on JSA. Primarily ensures they are actually "acknowledging" the signal to stop. This will touch various operators.

End of Report

Provided email conformation of report approval

Patrick Sharp
Railroad Safety Inspector- FRA IIC-Party Spokesperson
Federal Railroad Administration

Date: 07/28/21

Anthony Bernhard
Director of Engineering Safety- Party Spokesperson
Union Pacific Railroad

Date: 07/26/21

Roy Morrison
Director of Safety-Party Spokesperson
BMWED

Date: 07/27/21

John Gobert
Regional Service Manager-Party Spokesperson
Nordco Inc.

Date: 07/29/21