BNSF Railroad Collision
Kingman, Arizona
June 5, 2018

Accident Report

NTSB/RAR-21/01
PB2021-100919

National Transportation Safety Board

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Railroad Accident Report

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National Transportation Safety Board

490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

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Abstract: On June 5, 2018, about 2:50 p.m. local time, a westbound BNSF Railway intermodal train, S MEMSCO1 02L, was operating in multiple main track in centralized traffic control territory when it collided with the rear of a slow moving eastbound work train, WNEESGM1 05. The work train was making an eastbound reverse move to drop off an employee before traveling west to exit the main track. The collision occurred on main track 1 at milepost 480.2 in an area known as Crozier Canyon, about 33 miles east of Kingman, Arizona. The collision resulted in the death of one contract (Herzog Railroad Services, Inc.) employee who was traveling on the work train. Another Herzog employee was air lifted to a hospital in Las Vegas with serious injuries. Investigators determined that the probable cause of the accident was the failure of the BNSF Railway train crew of the intermodal train to operate in accordance with restricted speed requirements and stop short of the opposing train. Contributing to the accident was (1) BNSF Railway's failure to establish sufficient on-track safety and (2) the Federal Railroad Administration's interpretation of Title 49 *Code of Federal Regulations* Part 214 Subpart C that allows work trains to lay rail without using a form of on-track safety. The investigators focused on the safety issues of protection of roadway workers who foul a track and compliance with restricted speed requirements. As a result of the investigation, the National Transportation Safety Board makes two safety recommendations to the Federal Railroad Administration.

Contents

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Abbreviations and Acronyms

Amtrak	National Railroad Passenger Corporation
BNSF	BNSF Railway
CFR	*Code of Federal Regulations*
CTC	central traffic control
CWR	continuous welded rail
ETMS	electronic train management system
FRA	Federal Railroad Administration
MOW	maintenance-of-way
MP	milepost
NPRM	notice of proposed rulemaking
NTSB	National Transportation Safety Board
PTC	positive train control
RMM	roadway maintenance machine
RUM	rail unloading machine
U.S.C.	*United States Code*

Executive Summary

Accident Summary

On June 5, 2018, about 2:50 p.m. local time, a westbound BNSF Railway intermodal train, S MEMSCO1 02L, was operating in multiple main track in centralized traffic control territory when it collided with the rear of a slow moving eastbound work train, WNEESGM1 05. The work train was making an eastbound reverse move to drop off an employee before traveling west to exit the main track. The collision occurred on main track 1 at milepost 480.2 in an area known as Crozier Canyon, about 33 miles east of Kingman, Arizona. The collision resulted in the death of one contract (Herzog Railroad Services, Inc.) employee who was traveling on the work train. Another Herzog employee was air lifted to a hospital in Las Vegas with serious injuries.[1]

The loaded eastbound work train consisted of 29 cars and 2 forward-facing locomotives, was 1,800 feet long, and weighed 3,830 tons. After unloading rail on main track 1, the train headed east to drop off an employee. The work train was traveling up a 1.5 percent grade at about 9 mph on main track 1, approaching an 8° (sharp) curve at Crozier Canyon when the rail unloading machine on the rear of the work train and the lead locomotive of the westbound intermodal train collided.

The westbound intermodal train consisted of one forward-facing locomotive and two rear-facing locomotives at the front of the train and 72 loaded cars, was 6,574 feet long, and weighed 8,186 tons. After assuming the work train was headed west based on radio transmissions, the westbound intermodal train crew decided to proceed past a red restrictive signal at a speed slow enough, but not exceeding 15 mph, to permit stopping short of a train, a car, an obstruction, a stop signal, a derail, or an improperly lined switch. The train traversed a descending 1.5 percent grade reaching a top speed of 15 mph prior to reaching the 8° curve at Crozier Canyon, where tall trees on the inside of the curve impaired visibility. Both trains were operating with positive train control.

Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the BNSF Railway train crew of the intermodal train to operate in accordance with restricted speed requirements and stop short of the opposing train. Contributing to the accident was (1) BNSF Railway's failure to establish sufficient on-track safety and (2) the Federal Railroad Administration's interpretation of Title 49 *Code of Federal Regulations* Part 214 Subpart C that allows work trains to lay rail without using a form of on-track safety.

[1] For more information, see the factual information and analysis sections of this report. Additional information can be found in the public docket for this National Transportation Safety Board (NTSB) accident investigation (case number RRD18FR009) by accessing the Accident Dockets at www.ntsb.gov. For information about our safety recommendations, see the Safety Recommendation Database at the same website.

Safety Issues

- **Protection of Roadway Workers Who Foul a Track.** Federal Railroad Administration regulations state that roadway workers who foul the track are required to use a form of on-track safety. However, the Federal Railroad Administration's interpretation of the regulation is that it is acceptable for work trains with roadway workers fouling the track to perform work using only signal indications and restricted speed for protection.

- **Restricted Speed Accidents.** There are times when trains must be authorized to occupy the same sections of track. The use of restricted speed to allow following trains to enter a signal block occupied by another train is a common practice in the railroad industry. However, compliance with restricted speed requires consideration of multiple elements. In these cases, safe train operation relies solely on crewmember compliance with the railroad's restricted speed requirements.

Findings

- The following were not factors in the accident: the condition of the track, rail cars, or signal system; the weather; the use of cellular telephones by crewmembers; physical or mental impairment of train crewmembers due to alcohol, other impairing drugs, or fatigue; or the mechanical condition of the locomotives.

- All roadway workers fouling tracks should be afforded a method of on-track safety as defined in Title 49 *Code of Federal Regulations* Part 214.

- The exclusion of work trains from the requirements of Title 49 *Code of Federal Regulations* Part 214 does not provide on-track protections to all roadway workers on or near the tracks.

- Had the requirements of Title 49 *Code of Federal Regulations* Part 214 been applied to the work train in this accident, the intermodal train would either not have been permitted to enter the same signal block or not allowed to enter into established work limits, and the collision would not have occurred.

- The crewmembers of intermodal train S MEMSCO1 02L operated at a speed that did not allow their train to stop within half the range of vision as specified in Title 49 *Code of Federal Regulations* 236.812.

- Current training and oversight by supervisors are ineffective in ensuring the operating crew's use of restricted speed.

Recommendations

To the Federal Railroad Administration:

Require all railroads to establish working limits that prevent trains or other on-track machinery from entering zones where employees, including those who work on or from

maintenance-of-way equipment or on trains engaged in maintenance-of-way tasks, are working. (R-21-01)

Require all railroads to revise training and increase oversight to ensure that operating crews properly use restricted speeds. (R-21-02)

1 Factual

1.1 Accident Description

On June 5, 2018, about 2:50 p.m. local time, a westbound BNSF Railway (BNSF) intermodal train, S MEMSCO1 02L, was operating in multiple main track in centralized traffic control (CTC) territory when it collided with the rear of a slow moving eastbound work train, WNEESGM1 05.[1] The work train was making an eastbound reverse move to drop off an employee before traveling west to exit one of the two main tracks. Both trains were operating with positive train control (PTC) at restricted speed.[2] The collision occurred on main track 1 at milepost (MP) 480.2, in an area known as Crozier Canyon, about 33 miles east of Kingman, Arizona. Figure 1 shows the location of the collision and the direction of the trains. The collision resulted in the death of one contract (Herzog Railroad Services Inc. [Herzog]) employee who was traveling on the work train. Another Herzog employee traveling on the work train was airlifted to a hospital in Las Vegas with serious injuries.[3]

[1] (a) All times in this document are local time unless otherwise noted. (b) *Multiple main track* refers to two or more main line tracks used according to the timetables. (c) A *centralized control center* (CTC) *system* is a signaling system used to control rail traffic.

[2] (a) *Positive train control* (PTC) is a system of train control to prevent train-to-train collisions, enforce speed restriction, protect roadway workers and their equipment by preventing incursion into established work zones, and prevent the movement of a train through a main track switch in the improper position. (b) The Federal Railroad Administration (FRA) defines *restricted speed* as a speed that will permit a train or other equipment to stop within one-half the range of vision of the person operating the train or other equipment but not to exceed 20 mph, unless further restricted by the operating rules of the railroad (Title 49 *Code of Federal* Regulations [*CFR*] 236.812).

[3] For more detailed information about this accident investigation, see the National Transportation Safety Board (NTSB) public docket at https://data.ntsb.gov/Docket/Forms/searchdocket and search for accident number RRD18FR009.

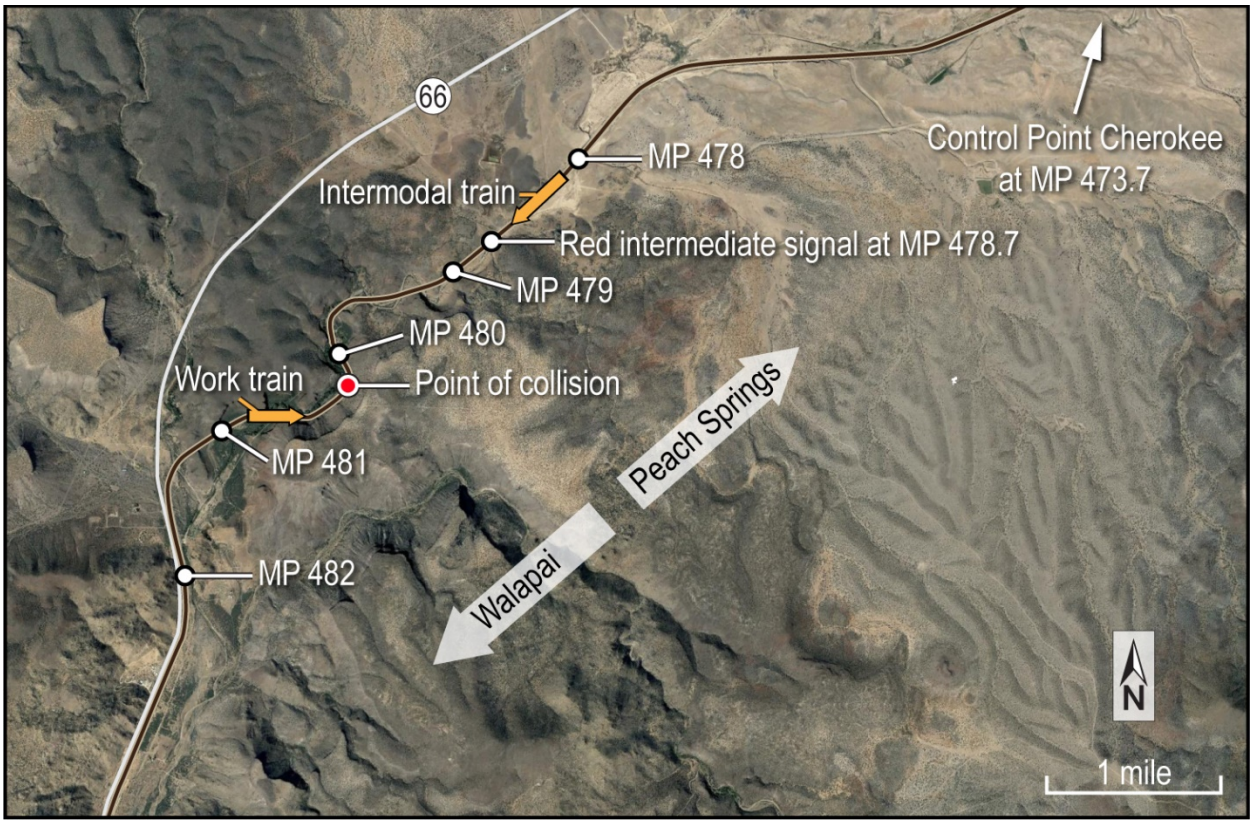

Figure 1. Layout of Crozier Canyon.

The loaded 29-car work train was operating in reverse (shoving) up an ascending 1.5 percent grade at about 9 mph in Crozier Canyon when the accident occurred. The train's operating crew consisted of an engineer, conductor, and brakeman.[4] The brakeman was positioned in the driver's seat in the cab of the rail unloading machine (RUM) at the rear of the train to watch for hazards during the shoving move.[5] There were two Herzog employees in a separate control cab of the RUM who operate the rail-unloading attachments. (See figure 2.) BNSF contracts out the Herzog RUM unit for its continuous welded rail (CWR) unloading operations.[6] See Section 1.7 for specific details on RUM operations. There were three other BNSF employees occupying the rail cars on tie-down platforms, which are walkways used to cross from one side of the rail cars to the other while unloading rail.

[4] A *brakeman* is a person who assists with train and yard operations.

[5] A *rail unloading machine* (RUM) is a mobile, self-contained road-to-rail distribution unit for hands-free precision rail placement. It can travel on highways and rails under its own power or can be coupled to a freight train. It unloads rail from a conventional CWR train using a rail crane and powered guide roller boxes.

[6] *Continuous welded rail* (CWR) is rail that has been welded together into lengths exceeding 400 feet.

Figure 2. Rail unloading machine.

The westbound intermodal train was 6,574 feet long, weighed 8,186 tons and consisted of one forward-facing locomotive, two rear-facing locomotives at the front of the train, and 72 rail cars.[7] The dispatcher requested a route to allow the westbound intermodal train on main track 1 to proceed behind the work train. According to interviews, the dispatcher's understanding was that a crew van had been arranged to pick up the work train crew at Walapai siding, which was west of the work location and that the work train was traveling west to exit the main track at the completion of their work.[8]

The westbound intermodal train stopped at an intermediate signal displaying a stop and proceed indication on main track 1, waiting for a more favorable indication.[9] While waiting, two westbound trains passed the intermodal train on main track 2, an adjacent track. About 10 minutes before the collision, the crew of the westbound intermodal train heard on the radio that the work train would clear the block in 45 minutes; this indicated to them, according to the engineer, that the work train was traveling west. The intermodal train crew proceeded past the red intermediate signal at restricted speed, which is allowed by operating rules. (See Section 1.4.1 for details.) The westbound intermodal train traversed the descending 1.5 percent grade using only dynamic braking

[7] *Forward facing* refers to the orientation of the locomotives that are designed to operate forward and reverse. When forward facing, the front of the locomotive is moving in the direction of the train's destination. A *rear-facing* locomotive allows the train to operate in the reverse direction.

[8] Train crews are transported by a crew van between job sites when necessary. On most railroads the train dispatcher orders transportation for road crews, and the yard master orders transportation for yard crews. In this case, the crew van was ordered by the dispatcher.

[9] An *intermediate signal* is a signal controlled automatically by rail traffic location, not by a dispatcher. Intermediate signals are usually placed on a main line between control points to space trains out that are traveling in the same direction, one behind the other.

at a speed of 15 mph prior to reaching an 8° curve in Crozier Canyon.[10] Although the maximum authorized restricted speed can be up to 20 mph, restricted speed requires the train crew be able to stop the train in one half the range of vision (Title 49 *Code of Federal Regulation* [*CFR*]) 236.812). In interviews with National Transportation Safety Board (NTSB) investigators, the conductor and engineer said that they felt that 15 mph was a safe speed.[11] Sight distance in the location of the accident was restricted by tall trees on the inside (west) of the curve as shown in figure 3.

Figure 3. Photo from train approaching accident curve from the east and facing west.

According to event recorder data, the crew of the westbound intermodal train applied the emergency brake while moving at 14 mph, and in 24 seconds, after traveling about 363 feet, it collided with the work train. The crew of the eastbound work train applied its emergency brake while moving at 9 mph 15 seconds after the westbound intermodal train applied its brakes. At the time of collision, the westbound intermodal train was traveling at 10 mph while the eastbound work train was traveling at 5 mph. (See figure 4.)

[10] *Dynamic braking* refers to the use of kinetic energy from a moving train used to generate a resistive electric current in the traction motors to slow or stop a train.

[11] For more information on any of the interviews discussed in this report, see interview transcripts in the NTSB public docket for RRD18FR009, accessible from the NTSB Accident Dockets web page.

The BNSF track supervisor, who was positioned on one of the car platforms, said he jumped off on the south side of main track 1 and landed on the south side of the tracks prior to the collision. The other two BNSF maintenance-of-way (MOW) employees held on and rode out the collision unharmed. The two Herzog employees riding in the control cab of the RUM remained inside.

The track laborer said that after the collision he saw the track supervisor trying to extract one of the two Herzog employees that were in the cab of the RUM. The track laborer ran over to the train crew of the westbound intermodal train to ask them to assist in extracting the Herzog employees trapped inside the RUM control cab. They pulled one of the Herzog employees free from the wreckage and provided first aid until help arrived. The other Herzog employee, who was fatally injured, had to be extricated by emergency personnel.

Figure 4. Overhead view of collision point. (Source: BNSF)

1.2 Seligman Subdivision

The Seligman Subdivision, shown in figure 5, is 1 of 10 subdivisions that comprise the BNSF Southwest Division. The Southwest Division spans from East Winslow, Arizona, to Needles, California, and consists of 286.6 miles of two main tracks and 7.3 miles of three main tracks, with seven passing sidings. The subdivision is equipped with a CTC signal system with an

overlay PTC system.[12] Timetable direction on the Seligman Subdivision is east and west.[13] The Seligman Subdivision operates both passenger and freight train services and averages two Amtrak (National Railroad Passenger Corporation) passenger trains and 79 freight trains a day.

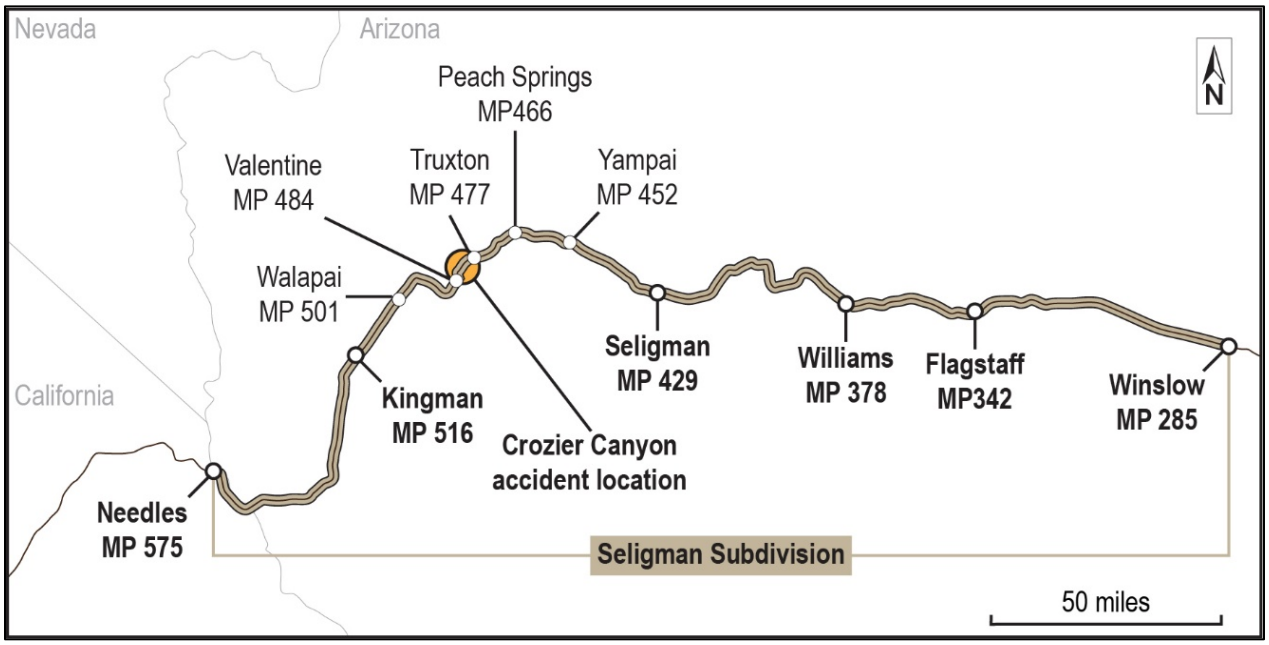

Figure 5. Layout of Seligman Subdivision.

1.3 Track Description

Traveling in a westward direction, the main tracks leading to the accident location at MP 480.2 on main track 1 consist of sharp left and right turns (curves) that switchback through a deep narrow valley. (See figure 6.) To the south of the accident location is a steep embankment with tall trees. Located to the north of the accident location is a tall rock formation with trees and undergrowth that obstruct the site distance of trains approaching from the west.

[12] An *overlay PTC system* is one that is overlaid on the existing system of operation and provides enforcement of movement authority limits, maximum authorized speeds, permanent and temporary speed restrictions, and incursion protection/limits/notifications into roadway work zones by a positive stop.

[13] *Timetable direction* refers to the geographical origin and termination locations of the trains. Often the track will be oriented on in differing compass directions due to geographical constraints.

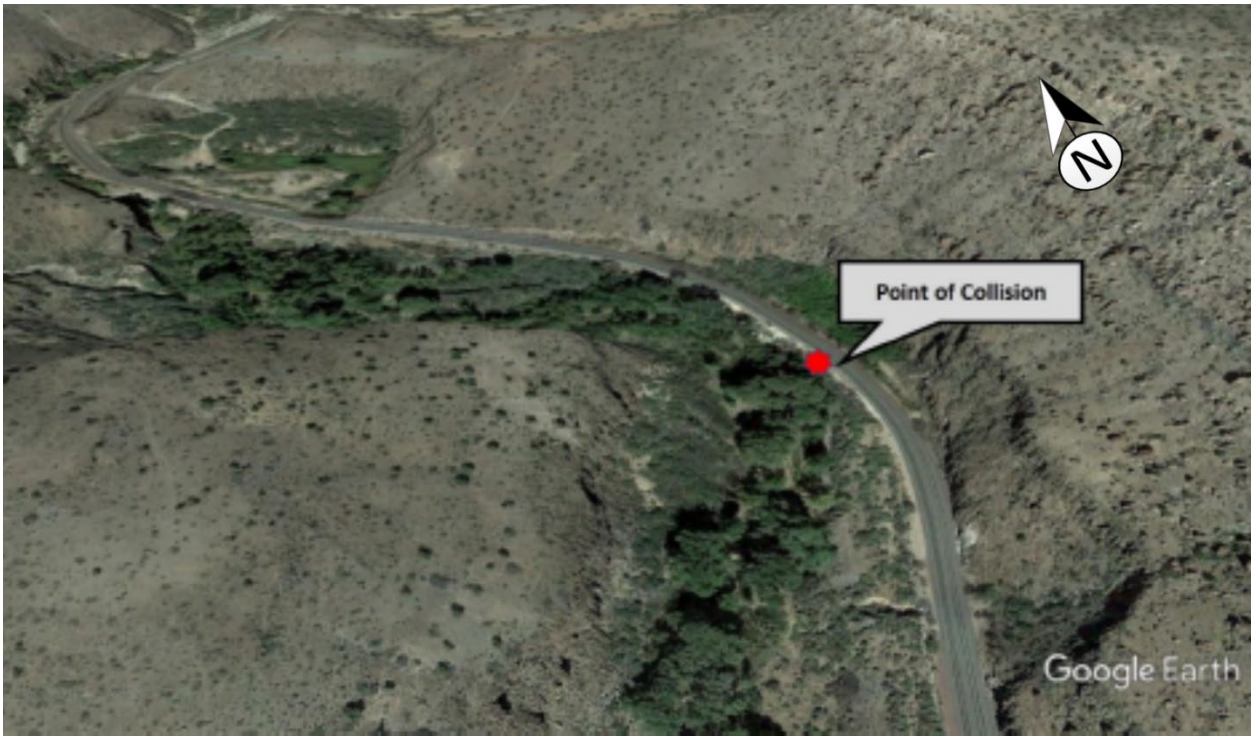

Figure 6. Crozier Canyon aerial view.

The Seligman Subdivision timetable lists permanent speed restrictions on both main tracks between MP 479.0 and MP 480.6, due to the descending track grades and degree of curvature. Both main tracks have permanent speed restrictions of 25 mph and are classified as Class 2 track under Federal Railroad Administration (FRA) regulations as stated in 49 *CFR* 213.9(a), with a maximum allowable speed of 25 mph for freight trains and 30 mph for passenger trains. Both main tracks are inspected and maintained to Class 2 track standards under 49 *CFR* 213.233(c).

1.4 Events Leading up to the Accident

1.4.1 Intermodal Train

The crew of the intermodal train consisted of a locomotive engineer and a conductor. They went on duty at 6:00 a.m., June 5, 2018, in Needles, California, their home terminal. Both crewmembers had more than the statutory off-duty period prior to reporting for duty.[14] The intermodal train was the second train the crew had operated that day, having operated another train from Franconia, Arizona, to Needles, California, that morning. The crew was subsequently dispatched to Peach Springs, Arizona, to take over the intermodal (accident) train, having been transported to that location by crew van. When the crew arrived, they took charge of the train,

[14] Title 49 *CFR* Part 228 requires that railroad operating employees not work over 12 hours in a given shift and must have a minimum of 10 hours off duty between shifts.

contacted the BNSF train dispatcher, initialized PTC, and headed west on a clear signal indication.[15]

After the train crew departed Peach Springs on track 1, they encountered three signal indications that required them to respond. The first was an approach medium (flashing yellow aspect) at control point Cherokee at MP 473.7. Their second signal indication was an approach (yellow aspect) at an intermediate signal at MP 476.6. The third signal was an intermediate signal displaying a restricting aspect (red aspect) at MP 478.7.[16] Operating rules allow train crews to proceed past a red intermediate signal at restricted speed, which is not to exceed 20 mph on BNSF tracks. The train crew stopped the train at the red signal instead of continuing at restricted speed because they stated, "Crozier Canyon is almost 3 miles long with blind curves." (See figure 7.)

Figure 7. View from two main tracks looking west toward the collision point.

[15] *Signal indication* refers to information conveyed by the aspect of the signal relative to speed and conditions on the track ahead. *Signal aspects* are as follows: *Clear signal* (green) means proceed; *approach medium* (flashing yellow) means proceed prepared to pass next signal not exceeding 40 mph and be prepared to enter diverging route at prescribed speed; *approach* (yellow) means proceed prepared to stop at next signal (trains exceeding 30 mph immediately reduce to that speed); and *restricting* (red) means stop and proceed at restricted speed.

[16] On the BNSF Railway, control point signals are often referred to by the restricting movement indication and milepost where they are located.

As the intermodal train came to a stop, the crew heard a radio transmission from the work train crew stating to the train dispatcher that they needed 45 more minutes to work. The crew of the intermodal train waited at the restricting signal at MP 478.7 for about an hour before they proceeded.

While they were stopped, the train crew observed two westbound trains that proceeded by them on main track 2. During an interview, the engineer said that he and the conductor decided to "creep" down and see what was going on. The conductor further stated that two trains with less priority passed his Z-train on the adjacent track, which should not have happened.[17] Z-trains are designated as high-priority trains. Mixed freight trains are a lower priority than the Z-trains.

The intermodal train crew then made the decision to proceed past the intermediate signal at MP 478.7 at restricted speed. The train crew was not required to contact the BNSF train dispatcher nor the work train to get additional information prior to initiating the westward movement. After the train passed the intermediate signal at MP 478.7, it gradually increased speed to 15 mph. The engineer said during the interview that he and the conductor knew that the work train was ahead of them. He said that in his mind he thought the work train was farther down the hill.

As the intermodal train proceeded west and traversed the right hand, 8° curve at Crozier Canyon, the crew's view was obstructed by trees and vegetation. (See figure 8.) As they rounded the curve, they came upon the work train. According to the engineer's interview, when the train crew first saw the approaching work train, they assumed it was traveling east on the adjacent track (main track 2). Moments later, both crewmembers realized it was on their track (main track 1). The engineer then applied the train's emergency brakes.

[17] A Z-train generally refers to a high-priority train carrying expedited freight.

Figure 8. Western view of westbound intermodal train looking toward the collision point. (Source: BNSF)

When the trains collided, the conductor on the intermodal train landed on top of the engineer. The lead locomotive of the intermodal train came to rest leaning to the right, and diesel fuel started to leak into the locomotive cab. Both crewmembers exited the locomotive and started looking for the crewmembers of the work train. They immediately found the brakeman of the work train who jumped before the collision. An employee that was part of the work train notified the engineer and conductor that there were two other employees trapped in the RUM on the south side of the tracks. The conductor said he pulled one of the employees out of the cab of the RUM. The deceased employee remained in the cab until he was removed by emergency responders.

1.4.2 Work Train

BNSF uses a freight train with specialized coupled flat cars for transporting long lengths of CWR to locations for loading and unloading operations. The CWR sections are positioned and stacked on the flatcars 6 rails high and 12 rails wide. The last flatcar in the CWR train is equipped with two working platforms or catwalks that span over the rails, where MOW employees are stationed to prepare the rails for either transport or unloading operations. (See figure 9.)

Figure 9. RUM unloading rail from CWR work train. (Source: BNSF)

The work train crew went on duty at 6:00 a.m., June 5, 2018, in Needles, California, its home terminal. The crew was transported to its train by the BNSF trainmaster. The work train was parked in the auxiliary track at control point Truxton, adjacent to main track 1. The crew took charge of the work train and had a job briefing with the MOW supervisor. During the job briefing the engineer asked if they were going to use track and time or Form B protection.[18] The assistant roadmaster told the engineer that the work train would be protected by signal indication.[19]

Under CTC, the dispatcher can grant track and time authority to the track foreman, vehicle operator, or work train. This authority protects the recipient's use of a designated track between locations where signals are controlled by the dispatcher (called control points). Form B is a type of track bulletin used to protect personnel and equipment in work zones on the track. It provides the time that a work zone is in effect, the foreman in charge, the MP limits, and whether trains must stop before entering the work zone and request permission to enter the work zone from the foreman in charge. Authorized protection is facilitated by yellow-red flags that must be displayed 2 miles before the restricted area. Protection will begin at a point, where a red flag will be displayed where the approaching train must stop and not proceed unless the employee in charge gives instructions.

[18] *Track and time* and *Form B* protections are types of roadway worker procedures and practices intended to prevent incursions into established work zones by other trains and are further explained in this report and describe in 49 *CFR* 214.321.

[19] A *roadmaster* is a field supervisor. In this case, an *assistant roadmaster* was supervising the MOW employees that were laying CWR.

At the time of the collision, eight workers were positioned on the work train (shown in figure 10) as follows:

- 1 BNSF engineer located in the front locomotive
- 1 BNSF conductor located in the front locomotive
- 3 BNSF MOW employees located on the flatcar platforms/catwalks
- 2 Herzog employees located in the RUM trailer cab (1 fatal and 1 severely injured)
- 1 BNSF brakeman located in the RUM's semi-cab driver seat

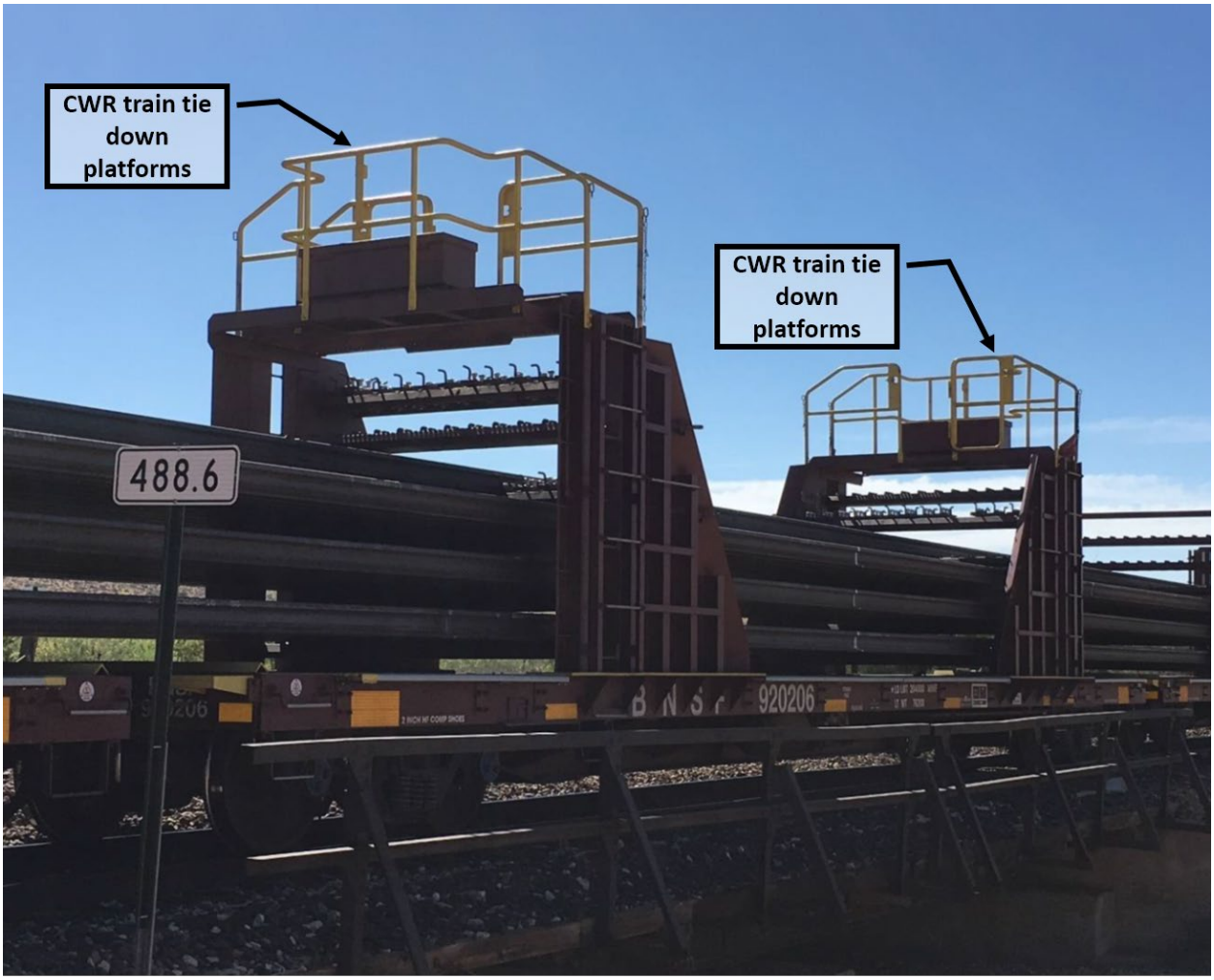

Figure 10. Tie-down platform on rail cars.

The engineer of the work train said that while they were laying CWR along the right-of-way, they were communicating using two radios, each on a different channel. The locomotive radio was on channel 60 and was used to communicate with the Herzog employees and MOW employees. The conductor's handheld radio was on channel 36 and was used to communicate with the BNSF train dispatcher. The engineer said that he was monitoring channel 60, and the conductor was monitoring channel 36. The brakeman was at the rear of the work train under the direction of the RUM operator (Herzog employee), who relayed instructions

to the engineer to move the work train east or west for a specified distance depending on the work. The engineer stated that there were times that the crew would switch channels on the locomotive radio from channel 60 to 36 to communicate with the BNSF train dispatcher.

The work train made several eastward and westward movements laying CWR on four curves on main track 2. The work train then crossed over to main track 1 and laid CWR on four curves before making the final reverse movement eastward prior to the incident. With the RUM attached to the rear of the work train, the speed was restricted to 10 mph during reverse movements and 15 mph in forward movements.

During his interview, the brakeman stated, "when we were done laying rail, we started shoving back (east) to drop off a MOW person at his truck. We entered the curve; I could see 10 cars, so I gave a 10-car count. Right after that, I saw the [intermodal] train coming around the corner."[20]

The brakeman initially thought the westbound intermodal train was traveling on the adjacent track (main track 2), and he called out over the radio "hot rail," indicating to other personnel that may be walking on or near the tracks that there is an approaching train on the adjacent track. The brakeman quickly realized the westbound intermodal train was also traveling on their track (main track 1) and called out an emergency on his radio while initiating an emergency brake application. The brakeman managed to jump out of the RUM truck on the north side of main track 1 prior to the collision.

1.4.3 Maintenance-of-Way Crew

The MOW crew, which was made up of BNSF and Herzog personnel, went on duty at 6:00 a.m. and completed the job briefing at Kingman, Arizona, then traveled to meet the work train crew at East Peach Springs. MOW workers lay, repair, and maintain track. This particular crew was assigned to unload CWR for a future project. See Section 1.7 for more detail on the MOW crew's specific RUM operation duties. The job briefing was conducted by the BNSF MOW supervisor with the MOW crew and the work train crew who were all BNSF personnel. The job briefing consisted of a description of the rail unloading work to be performed and everyone's responsibilities. The track supervisor emphasized that anyone could stop the operation if they believed there was a hazardous safety risk. The engineer of the work train asked a second time if they were going to work under a form B or track and time. The BNSF assistant roadmaster said that the work train's form of protection would be provided by the train crew contacting the train dispatcher and through signal indication, which is neither Form B nor track and time.[21] During a postaccident interview, the assistant roadmaster was asked who makes the decision on the method of protection for a work train. She replied, "It's always signal indication" and that "they don't unload rail under track and time although it's not impossible, but they would have to get three

[20] Railroad employees use rail car lengths to describe sight distance and that the track for their movement is clear for that distance. In this case the brakeman's description means he could see ahead 10 car lengths. A typical railroad car is about 50 feet long.

[21] See section 1.4.2 for clarification on Form B and track and time.

blocks in a row."[22] The assistant roadmaster further explained that it would not make sense to use a form B or track and time to unload rail, stating that signal indication shad always been used for this type of work This is for the convenience of staging rail with less delay for other trains.

The assistant roadmaster also said that it did not make sense to line another train behind a work train that is going back and forth, stopping, and going slow. When asked if she was familiar with the signal indications, her reply was, "Kind of. It goes red, flashing yellow, and something else. I don't—yellow, green. I don't know." The assistant roadmaster explained that the main concern was safety from trains passing on the adjacent track and not the trains traveling on the same track as the work train.

1.4.4 Dispatching

The first shift train dispatcher went on duty at 5:30 a.m. He said that upon coming on duty he had a job briefing with the outgoing train dispatcher. He dispatched the work train out of Truxton eastbound on main track 1 and crossed it over to main track 2 at Cherokee. The train dispatcher said that while he was on duty the work train remained working on main track 2 until he went off duty. The train dispatcher was asked how he provided protection to the work train. He stated, "The signal system was their only protection when I was working with them. Other than that—they were just on signals." (See figures 1 and 4.)

The first shift train dispatcher explained that to protect the area in which the work train would be operating up and down the track from control point to control point., he could place restrictive informational tags on his computer screen or block the signals at the control points and dispatch trains around the work train on the adjacent main track. At the time, these tags were not required by BNSF to be used to protect work trains. Restrictive informational tags were commonly used when work limits were established using form B. During an interview, the train dispatcher indicated he did not provide additional information to other trains when a work train was performing work.

The second shift train dispatcher went on duty at 12:30 p.m. He said he had a job briefing with the first shift dispatcher on the trains that were operating on the Seligman Subdivision. He said that he did not dispatch the work train from main track 2 to main track 1. He said that the train was already operating on main track 1 when he went on duty. He also said that he did not communicate with the crew on the intermodal train and that he did not dispatch the intermodal train from East Peach Springs. The second shift train dispatcher indicated he did give a "proceed" signal to the intermodal train at Cherokee to continue westward. He explained that when he went on duty, he had a notification that a crew van had been ordered to pick up the work train crew at Walapai. The dispatcher further stated that it was his understanding the work train was done and would be heading west from Cherokee to Walapai because the crew van had been ordered for the crew. The dispatcher did not receive a radio transmission from the work train that it was done.

[22] A *block* is a length of track of defined limits, used by trains and governed by *block signals* (fixed signals at the entrance of a block to govern trains and engines entering and using that block), cab signals, or both. A *cab signal* is in the train cab and indicates a condition affecting the movement of the train and is used in conjunction with interlocking signals and in conjunction with or in lieu of block signals.

The second shift train dispatcher explained the reason he gave the intermodal train a proceed indication at the Cherokee control point to follow the work train on main track 1, stating he thought the work train was operating westbound. He also said that the work train did not have bi-directional authority (track and time), which allowed him to dispatch the intermodal train behind the work train, and that, per signal indication and operating rules, "is perfectly fine."

The second shift train dispatcher said during the interview that after noticing that the work train was not moving, he made nine attempts to communicate with the work train crew. He wanted to know the reason for the delay. Eventually, the work train crew contacted the train dispatcher and explained that they would be done at Hackberry, which was west of Crozier Canyon at MP 489, in about 45 minutes. The train dispatcher assumed that the work train crew had completed their work and that they were traveling west to their final destination.

1.5 Personnel Information

The intermodal train engineer was hired on December 16, 2011, and was certified as an engineer on May 30, 2017.[23] The engineer received 14 operational tests in the previous year and was found in compliance with operating rules. The intermodal train conductor was hired on September 30, 2013, and was certified as a conductor on January 10, 2017. The conductor received 27 operational tests in the previous year and was found in compliance with operating rules.

The work train engineer was hired on November 23, 1998, and was certified as an engineer on July 19, 2017. The engineer received 14 operational tests in the previous year and was found in compliance with operating rules. The work train conductor was hired on February 23, 2004, and was certified as a conductor on December 4, 2016. The conductor received 16 operational tests in the previous year and was found in compliance with operating rules. The work train brakeman was hired on October 21, 2013, and passed the certification rules exam on February 15, 2018. The brakeman received 16 operational tests in the previous year and was found in compliance with operating rules.

1.5.1 Drug and Alcohol Test Results

FRA postaccident forensic toxicology test results were negative for the one fatality, the engineers and conductors for both trains, and MOW crew.[24]

1.5.2 Cellular Phone Use

NTSB investigators obtained cellular phone records for the operating crew employees. After reviewing these records, they determined there was no indication of usage while either crew were operating their train.

[23] See 49 *CFR* Part 240 Qualification and Certification of Locomotive Engineers and Part 242 Qualification and Certification of Conductor for specific requirements.

[24] FRA postaccident toxicology testing tests urine specimens for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, MDMA/MDA (Molly/Sally), methadone, opiates/opioids, phencyclidine, tramadol, brompheniramine, chlorpheniramine, diphenhydramine, doxylamine, pheniramine, and blood alcohol level.

1.6 Positive Train Control System

PTC was in effect on the BNSF Seligman Subdivision, and both trains were equipped with and operating with PTC. BNSF uses Wabtec's Electronic Train Management System (ETMS), which establishes signals as targets.[25] When operating using ETMS, a red intermediate signal is a target that requires restricted speed. ETMS is designed to enforce the upper limit of restricted speed, which is 20 mph on BNSF tracks. As currently designed, upon reaching 3 mph over the 20-mph restriction (23 mph), a visual alarm is displayed, and an audible alarm sounds. If the engineer does not take action to reduce speed in a certain amount of time based on train speed and a braking algorithm, a full-service penalty brake application is applied automatically to bring the train to a stop.[26]

A red absolute (solid red) signal is also a target. The ETMS calculates a safe braking profile for a train and automatically stops a train short of a stop signal if the engineer does not take action to slow and then stop the train. As currently designed, the rear of a standing train is not an ETMS target.

When ETMS is in effect, it means that PTC does not enforce penalties below 20 mph on BNSF tracks, including this 15 mph move, so essentially PTC is non-operational below 20 mph and was not operational prior to this accident.

1.7 Rail Unloading Machine Operations

Herzog designed the RUM, a U.S. Department of Transportation–approved over-the-road tractor-trailer type truck with an attached rear-working trailer assembly that is equipped with both rubber tires and retractable railroad wheels, which makes it capable of traveling on railroad tracks. It is self-propelled and powered as a single unit, or coupled to and powered by a freight train, via a normal railroad coupler. BNSF contracts out the Herzog RUM unit for its CWR unloading operations. At the time of the collision the RUM was coupled to the rear of the BNSF work train and configured to operate on the rails.

The rear-working trailer is equipped with hydraulic extending "boom type" arms and rail-handling attachments that unload rail from a CWR train and strategically place the CWR in staked-out locations. The rear-working trailer is attached to the truck via a fifth-wheel or tractor trailer attachment. The rear-working trailer is equipped with a two-person operating cab equipped with two high-back captain's chairs, where employees are seated to operate the joystick-controlled rail-unloading attachments. Herzog contract employees operate the CWR rail-handling attachments and direct the movement of the CWR work train through radio communications with the work train conductor and engineer. When coupled to the rear of a work freight train, a BNSF brakeman is positioned inside the cab of the RUM to protect the trains when completing backing or shoving moves by providing a clear sight distance measurement to the engineer and conductor.

[25] *Electronic Train Management System* (ETMS) is an overlay technology that augments existing train control methods. ETMS uses Global Positioning System for positioning and a digital radio system to monitor train location and speed.

[26] A *penalty brake application* is an automatic application of air brakes caused by a locomotive overspeed or by the release of a safety control foot pedal with the locomotive brakes released.

1.8 Event Recorders

Time-sequencing data retrieved from event recorders for the trains involved in this accident during the brief period before and up to the point of the collision was analyzed. A summary of the time sequence is provided in Section 1.1 of this report. A detailed report of this time-sequencing data can be found in the factual report for this investigation in the NTSB public docket for RRD18FR009.

1.9 Postaccident Actions

On August 1, 2018, BNSF added the following additional information to its System Safety Instruction 29, Trains Performing Track Maintenance Work:

> At the intended work location in signaled territory and before performing work associated with track maintenance, such as dumping ballast, loading/unloading track materials, etc., on a main track or siding, the conductor must (1) notify the train dispatcher of the milepost limits where the work will be performed and (2) notify the train dispatcher when the work has been completed.

Also, on August 1, 2018, BNSF released a new dispatcher rule, TDCOM 40.28, Trains Performing Work Associated with Track Maintenance, which stated that in signaled territory, when notified by the conductor of a train performing track maintenance work such as dumping ballast, loading/unloading track materials, etc., the following are required in CTC:

- Conduct a job briefing with the conductor to ensure a clear understanding of the milepost limits to be used by the train performing track maintenance work.
- Place a restrictive informational tag(s) in the control system at the affected location and notify any following train within the same limits about the train performing track maintenance work and the limits where it is working.
- Prior to authorizing a train to enter a track that allows direct access to the milepost limits identified by the conductor of the train performing track maintenance work, inform the crew of the train being authorized about the train performing track maintenance work and the limits where they are working.

Additionally, the following are required in automatic block signaling:[27]

- Conduct a job briefing with the conductor to ensure a clear understanding of the milepost limits to be used by the train performing track maintenance work.
- Place a restrictive informational tag(s) in the control system at the affected location and notify any following train(s) within the same or overlapping limits about the train performing track maintenance work and the limits where they are working.

[27] *Automatic block signaling* is a signal system that divides the main tracks into separate blocks and automatically controls train movement based on locations from block to block.

- Maintain the restrictive informational tag and continue notifications until advised by the conductor that track maintenance work is complete.

1.10 Tests and Inspections

1.10.1 Postaccident Signal System

Investigators conducted postaccident field inspections and testing of the signal system. The inspections found no indications of tampering or vandalism that would interfere with the operation of the signal system. Relay positions were found to be in accordance with the physical location of the impacted trains and the displayed signal aspects. Investigators did not identify any exceptions with either the design or the operation of the signal system.[28]

Investigators collected and reviewed BNSF signal system maintenance records for the accident area. The records indicated that all signal tests and inspections had been conducted in accordance with BNSF requirements and federal regulations. Signal trouble reports for the previous 3 months were also reviewed, and no exceptions were noted.

1.10.2 Track

BNSF operated a track geometry car and conducted inspections over the Seligman Subdivision on main track 1 between MP 480.0 and MP 481.0 on January 24, 2018, and May 23, 2018. These inspections covered the collision site location, to include a portion measuring roughly 1,056 feet east and west of the collision site location. Investigators found BNSF's track geometry car data to be acceptable.

A postaccident walking inspection was performed on main track 1 between MP 480.0 and MP 480.4, roughly 2,000 feet of track. Track gauge and cross-level measurements were taken throughout the accident site location and were found in compliance with BNSF track maintenance practices and 49 *CFR* Part 213.9(a) standards for Class 2 track operation. Investigators determined that about 40 feet of track was damaged from the collision and subsequent derailment of the two trains.

1.10.3 Mechanical

On June 7, 2018, investigators conducted a locomotive air brake departure test at the BNSF Hackberry Yard on the locomotives that were attached to both the intermodal and work trains, based on the standards set forth in 49 *CFR* Part 232. The locomotives tested were BNSF 5377 and BNSF 4919 from the intermodal train, as well as locomotives BNSF 6613 and BNSF 6219 from the work train. The brake test was satisfactory; the locomotive brakes applied and released without exception, and the brake components showed normal wear patterns. Locomotive BNSF 4283, the lead locomotive on the intermodal train at the time of the collision, could not have its brakes tested due to extensive damage to the brake system.

[28] For details on signal system standards and design see 49 *CFR* Part 236 Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances.

Also tested were the air brakes from the front 27 freight cars on the work train. The rear two cars could not be tested due to extensive damage to the air brake system. The brake test was satisfactory; the brakes applied and released as designed, and the brake components showed normal wear patterns. No FRA brake test defects were found during the inspection.

On June 8, 2018, the 72 freight cars from the intermodal train were inspected at BNSF Yorba Linda Yard in Yorba Linda, California, by FRA inspectors. FRA inspectors conducted a Class I air brake test and examined the cars for compliance with 49 *CFR* parts 232, 215, and 231. No exceptions were noted that would have affected the trains performance in this incident.

1.10.4 Sight Distance

On June 10, 2018, investigators conducted sight distance observations using similar railroad locomotives to those involved in the collision. Three observations were conducted at approximately the same time of day and same location as the collision (MP 480.2) while moving at a speed of 3-4 mph for each scenario.

- Scenario 1 – Sight distance from westbound locomotive to stationary Herzog equipment: Investigators in the exemplar locomotive were able to identify the RUM truck at a distance of 1,348 feet. They were then able to identify that the RUM truck was on main track 1 at a distance of 1,240 feet.
- Scenario 2 – Sight distance from eastbound RUM truck to stationary locomotive: Investigators in the RUM truck were able to identify the exemplar locomotive at a distance of 571 feet. They were then able to identify that the locomotive was on main track 1 at a distance of 543 feet.
- Scenario 3 – Sight distance from westbound locomotive and eastbound RUM truck: Investigators in the RUM truck were able to identify the exemplar locomotive at a distance of 408 feet. They were then able to identify the locomotive was on main track 1 at a distance of 312 feet.

1.11 Roadway Worker Protection

The FRA uses a compliance manual that provides the railroad industry with interpretations and guidance on the railroad workplace safety regulations covered in 49 *CFR* Part 214 Subpart C, dividing the interpretations and guidance into seven subparts: introduction, summary, principles, railroad on-track safety programs, documentation of on-track safety programs, section-by-section guidance on roadway protection rule, and appendix on defect codes.[29]

The FRA's summary of the roadway worker protection subpart in part states that "The Roadway Worker Protection Rule requires railroads and contractors to railroads to devise and adopt procedures to protect their roadway worker employees from being struck by trains and other on-track machinery." It also requires "roadway workers to follow the on-track safety procedures to protect themselves and others dependent upon them. Each railroad employer is required to have

[29] *On-track safety* is a state of freedom from the danger of being struck by a moving railroad train or other railroad equipment, provided by operating and safety rules that govern track occupancy by personnel, trains, and on-track equipment.

in place an on-track safety program, including rules, procedures, training, and equipment, to be used for the protection of roadway workers." MOW workers are considered roadway workers.

The FRA's summary of the roadway worker protection subpart is based on the following five principles:

1. A person not fouling a track will not be struck by a train.[30]
2. A person who is fouling a track upon which a train will not move will not be struck by a train.
3. No person should foul a track unless that person (a) knows that no train will arrive or (b) will be able to move to a place of safety before the train arrives.
4. Each roadway worker bears the ultimate responsibility for his or her on-track safety.[31]
5. Each employer is responsible for providing the means for achieving on-track safety to each roadway worker employee.

[30] "*Fouling a track* is the placement of an item of equipment or an individual in such proximity to a track that the equipment or individual could be struck by a moving train or on-track equipment, or in any case, is within four feet of the field side of the near running rail" as defined in 49 *CFR* 214.7.

[31] A *roadway worker* is "any employee or contractor of a railroad whose duties include inspection, construction, maintenance, or repair of railroad track; bridges; roadway; signal and communication systems, electric traction systems, roadway facilities or roadway maintenance machinery on or near track or with the potential of fouling a track and, flagmen and watchmen/lookouts" as defined in 49 *CFR* 214.7.

2 Analysis

At about 2:50 p.m. on June 5, 2018, westbound intermodal train S MEMSCO1 02L collided with a RUM at the rear of CWR work train W NEESGM1 05, which was making a temporary eastbound reverse move on the same track to drop off an employee at his vehicle before traveling west to exit the main track. The collision occurred on main track 1 at MP 480.2, in Crozier Canyon, while the work train was shoving up the grade at 9 mph, and the intermodal train was negotiating its descent into the 8°curve at a maximum speed of 15 mph.

2.1 Exclusions

The track, signal system, locomotives, and rail cars were inspected, tested, and examined by investigators, and no defects were found to have caused or contributed to this collision. Further, the intermodal and work trains had received the federally required air brake tests and inspections before they departed their points of origin before the collision, and no discrepancies were documented in the records. Signal system data and postaccident tests and inspections indicated that the signals were functioning as designed at the time of the collision. The collision occurred in daylight with dry weather, and visibility restrictions related to weather and environmental light conditions were not considered a factor.

Investigators obtained telephone records of personal cellular phones belonging to both train crews. The records indicated that no calls or texts were initiated or received during the trip leading up to the collision by the crewmembers of either train.

The results of postaccident toxicological tests performed on the members of both crews, including the one fatality, were negative for alcohol and other impairing drugs.

The NTSB, therefore, concludes that the following were not factors in the collision: the condition of the track, rail cars, or signal system; the weather; the use of cellular telephones by crewmembers; physical or mental impairment of train crewmembers due to alcohol, other impairing drugs, or fatigue; or the mechanical condition of the locomotives.

2.2 Protection of Roadway Workers Who Foul a Track

NTSB investigators questioned the FRA regarding railroad workplace safety in reference to this accident. They were asked if the BNSF Engineering Department employees and contractors working to unload rail from the rail train were considered roadway workers according to their workplace safety definition, if those workers were considered to be fouling the track that the work train was occupying, and what form of on-track safety was needed to protect the roadway workers.

The FRA stated that according to the definition of “roadway worker” in Subpart A of its Railroad Workplace Safety regulation (49 *CFR* 214.7), the BNSF Engineering Department employees and contractors on board the work train at the time of the accident were considered roadway workers. Based on the definition of “fouling a track” in 49 *CFR* 214.7, which includes placement of equipment in a position where it could be struck by a moving train and the use of the RUM coupled to the work train, the FRA stated that the roadway workers were fouling the track.

At the time of the accident, the employees were in or on a train operating under the authority of the operating rules of the railroad and thus were not required to establish on-track safety under Subpart C of Part 214. Under 49 *CFR* 214.301(c), roadway worker protection does not apply to "movements of roadway maintenance machines that are conducted under the authority of a train dispatcher, a control operator, or the operating rules of the railroad." FRA's Roadway Worker Protection Compliance Manual explains that 49 *CFR* 214 Subpart C applies to the protection of individual roadway workers from being struck by roadway maintenance machines (RMM) but does not apply to how RMMs are protected from trains and other roadway maintenance machinery by the operating rules of the railroad.[32] The FRA interprets this that when roadway workers are in or on an RMM and that RMM is operating under the authority of a train dispatcher, a control operator, or the operating rules of the railroad, those roadway workers would not require additional on-track protection.

FRA's interpretation is that while a "train" is not an RMM, the same rationale behind 49 *CFR* 214.301(c) applies, and the risk to roadway workers is less when they are on or in a train as opposed to an RMM, which is often smaller and offers less protection than a train. In both cases, the roadway workers are protected by the train or RMM's authority to occupy the main track. This authority is provided by a train dispatcher, a control operator, or the operating rules of the railroad. In the case of the Kingman collision, the BNSF assistant roadmaster did not establish on-track safety as defined by the 49 *CFR* Part 214 regulation. Instead, the work train was using the operating rules of the railroad, specifically rules for restricted speed. The train dispatcher and the intermodal train crew assumed that the work train had completed staging the rail and was traveling west as a normal train movement. Therefore, the train dispatcher authorized the intermodal train to proceed by signal indication behind the work train.

In 1996, the Roadway Worker Protection Advisory Committee found, and the FRA agreed, that although the definition of restricted speed found under 49 *CFR* Part 214 provides adequate separation between trains and on-track machines in a travel mode, a blanket provision that would rely on restricted speed to protect persons working while fouling the track would not be an effective form of protection. The Advisory Committee's finding was based on an analysis of on-track safety practices conducted in 1995 by a task force composed of representatives of several railroads and labor organizations. The FRA published a final rule establishing the original roadway worker protection regulation on December 16, 1996, which became effective January 15, 1997.[33] The final rule largely incorporated the Advisory Committee's recommendations.

In the Kingman collision, the work train was occupying a portion of the track that it was authorized to occupy. The intermodal train was also authorized by rule to proceed past the red (stop and proceed) signal and occupy the same track. The signal system did not protect the RMM or the roadway workers.

The FRA interpretation does not require work train service such as laying rail to establish a form of on-track safety. Had the FRA also interpreted 49 *CFR* Part 214 to protect all roadway

[32] A "*roadway maintenance machine* (RMM) is a device powered by any means of energy other than hand power that is being used on or near railroad track for maintenance, repair, construction, or inspection of track, bridges, roadway, signals, communications, or electric traction systems" as defined in 49 *CFR* 214.7. RMMs may have road or rail wheels or may be stationary.

[33] *Federal* Register. 1996. Vol. 61, no. 242 (December 16): 65959.

workers to include those who are operating from a work train, the MOW crew would have established a form of on-track protection as required by 49 *CFR* Part 214, and the work group would have had control of trains entering its working limits. Approaching trains would have been required to receive authority from the work train crew to enter the limits. Direct communication between trains and the MOW crew to enter the working limits would have been required. The train dispatcher would not have had to make assumptions as to the location or direction of the work train before authorizing a following train movement.

In summary, 49 *CFR* 214.301(c) states that the purpose of the subpart is to prevent accidents and casualties caused by moving railroad cars, locomotives, or RMMs striking roadway workers or RMMs. It prescribes the safety standards related to the movement of RMMs where such movements affect the safety of roadway workers, but the subpart does not otherwise affect movements of RMMs that are conducted under specific authorities.

In this accident, an intermodal train struck an RMM that was occupied by roadway workers that were fouling the track. However, the FRA's interpretation of 49 *CFR* Part 214 regulations does not require any form of on-track safety for RMMs. Even though the regulations state that a roadway worker fouling a track requires protection, the FRA's interpretation of the regulations is that on-track safety protection was not required in this incident. In this accident, the only protection provided to these roadway workers was restricted speed rules. As currently written, the NTSB interprets 49 *CFR* 214 to require that all roadway workers that foul tracks must have some form of on-track safety. The FRA's position is that restricted speed is not an effective measure to protect roadway workers; however, in this accident the FRA did not take exception to the rail unloading operation not having a protection method in place. The same hazards exist for any roadway worker who is fouling tracks regardless of whether they are on an RMM operating under the authority of train dispatcher, a control operator, or the operating rules of the railroad. Therefore, the NTSB concludes that all roadway workers fouling tracks should be afforded a method of on-track safety as defined in 49 *CFR* Part 214.

The NTSB surveyed representatives from Class I railroads, including Union Pacific, Canadian National, CSX Transportation, Norfolk Southern, and Amtrak, to determine if they provide a form of on-track safety while laying rail. All the surveyed railroads stated that they always use a form of on-track safety while laying rail. A representative of Herzog stated that besides BNSF, they are laying rail using the RUM vehicle on the rear of a work train on Union Pacific Railroad and Canadian National Railway and just received a contract for the same on CSX Transportation. Herzog stated that on Union Pacific Railroad and Canadian National Railway, they lay rail using only signal indication. Based on the results of the surveyed Class I railroads, there is an inconsistency among them as to the type of protections used when they are laying rail from a work train.

The NTSB concludes that the exclusion of work trains from the requirements of 49 *CFR* Part 214 does not provide on-track protections to all roadway workers on or near the tracks. Further, the NTSB concludes that had the requirements of 49 *CFR* Part 214 been applied to the work train in this accident, the intermodal train would either not have been permitted to enter the same signal block or not allowed to enter into established working limits, and the collision would not have occurred. Therefore, the NTSB recommends the FRA require all railroads to establish working limits that prevent trains or other on-track machinery from entering zones where

employees, including those who work on or from MOW equipment or on trains engaged in MOW tasks, are working.

2.3 Restricted Speed Accidents

The FRA defines restricted speed as a speed that will permit a train or other equipment to stop within one-half the range of vision of the person operating the train or other equipment but not to exceed 20 mph, unless further restricted by the operating rules of the railroad (49 *CFR* 236.812).

During train operations, the signal system or train dispatcher can provide safe separation between trains moving in either the same direction or the opposite direction. However, there are times when trains must be authorized to occupy the same sections of track. In these cases, safe train operation relies solely on train crew compliance with the railroad's restricted speed requirements.

The use of restricted speed to allow following trains to enter a signal block occupied by another train is a common practice in the railroad industry. However, compliance with restricted speed requires consideration of multiple factors. The maximum speed allowed is 20 mph. Seldom do the conditions allow a train to be safely operated at this maximum. According to the FRA, the most significant consideration when complying with restricted speed is if it "allows stopping within half the range of vision" as stated in 49 *CFR* 236.812. The judgement of the operating crew is critical in determining a safe speed while operating under the conditions of restricted speed. In this accident, the crew needed to consider the descending grade that extended the braking distance of the train and the track curvature (that included vegetation obstructing the view) that limited visibility. During interviews, the crewmembers indicated that they were fully aware of the descending grade and the limited visibility. Further, they had information that there was potentially a train in front of them. The NTSB concludes that the crewmembers of intermodal train S MEMSCO1 02L operated at a speed that did not allow their train to stop within half the range of vision as specified in 49 *CFR* 236.812. The NTSB further concludes that current training and oversight by supervisors are ineffective in ensuring the operating crew's use of restricted speed. Therefore, the NTSB recommends the FRA require all railroads to revise training and increase oversight to ensure that operating crews properly use restricted speeds.

3 Conclusions

3.1 Findings

1. The following were not factors in the accident: the condition of the track, rail cars, or signal system; the weather; the use of cellular telephones by crewmembers; physical or mental impairment of train crewmembers due to alcohol, other impairing drugs, or fatigue; or the mechanical condition of the locomotives.

2. All roadway workers fouling tracks should be afforded a method of on-track safety as defined in Title 49 *Code of Federal Regulations* Part 214.

3. The exclusion of work trains from the requirements of Title 49 *Code of Federal Regulations* Part 214 does not provide on-track protection to all roadway workers on or near the tracks.

4. Had the requirements of Title 49 *Code of Federal Regulations* Part 214 been applied to the work train in this accident, the intermodal train would either not have been permitted to enter the same signal block or not allowed to enter into established working limits, and the collision would not have occurred.

5. The crewmembers of intermodal train S MEMSCO1 02L operated at a speed that did not allow their train to stop within half the range of vision as specified in Title 49 *Code of Federal Regulations* 236.812.

6. Current training and oversight by supervisors are ineffective in ensuring the operating crew's use of restricted speed.

3.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the failure of the BNSF Railway train crew of the intermodal train to operate in accordance with restricted speed requirements and stop short of the opposing train. Contributing to the accident was (1) BNSF Railway's failure to establish sufficient on-track safety and (2) the Federal Railroad Administration's interpretation of Title 49 *Code of Federal Regulations* Part 214 Subpart C that allows work trains to lay rail without using a form of on-track safety.

4 Recommendations

As a result of this investigation, the National Transportation Safety Board makes the following new safety recommendations:

To the Federal Railroad Administration:

Require all railroads to establish working limits that prevent trains or other on-track machinery from entering zones where employees, including those who work on or from maintenance-of-way equipment or on trains engaged in maintenance-of-way tasks, are working. (R-21-01)

Require all railroads to revise training and increase oversight to ensure that operating crews properly use restricted speeds. (R-21-02)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

ROBERT L. SUMWALT, III
Chairman

BRUCE LANDSBERG
Vice Chairman

JENNIFER HOMENDY
Member

MICHAEL E. GRAHAM
Member

THOMAS B. CHAPMAN
Member

Adopted: May 10, 2021

Appendix A: Investigation

The National Transportation Safety Board (NTSB) was notified on June 5, 2018, of the accident in which a westbound intermodal train collided with a rail unloading machine coupled to the rear of an eastbound work train, killing one employee.

The NTSB launched an investigator-in-charge, who was the on-scene spokesperson, a track investigator, and an operations investigator.

The parties to the investigation include the BNSF Railway, Federal Railroad Administration, Brotherhood of Locomotive Engineers and Trainmen, International Association of Sheet Metal, Air, Rail and Transportation Workers, Arizona Commerce Commission, Herzog Railroad Services, Inc., and the Brotherhood of Maintenance of Way Employes.[1]

[1] The Brotherhood of Maintenance of Way Employes Division of the International Brotherhood of Teamsters officially spells "Employes" with one "e."

Appendix B: Consolidated Recommendation Information

Title 49 *United States Code* (*U.S.C.*) 1117(b) requires the following information on the recommendations in this report.

> For each recommendation—
>
> (1) a brief summary of the NTSB's collection and analysis of the specific accident investigation information most relevant to the recommendation,
>
> (2) a description of the NTSB's use of external information, including studies, reports, and experts, other than the findings of a specific accident investigation, if any were used to inform or support the recommendation, including a brief summary of the specific safety benefits and other effects identified by each study, report, or expert, and
>
> (3) a brief summary of any examples of actions taken by regulated entities before the publication of the safety recommendation, to the extent such actions are known to the Board, that were consistent with the recommendation.

To the Federal Railroad Administration

R-21-01

> Require all railroads to establish working limits that prevent trains or other on-track machinery from entering zones where employees, including those who work on or from maintenance-of-way equipment or on trains engaged in maintenance-of-way tasks, are working. (R-21-01)

Information that addresses the requirements of 49 *U.S.C.* 1117(b), as applicable, can be found in section 2.2 Protection of Roadway Workers Who Foul a Track. Information supporting (b)(1) can be found in sections 1.4.3 Maintenance-of-Way Crew, 1.10.4 Sight Distance, and 1.11 Roadway Worker Protection; (b)(2) is not applicable; information supporting (b)(3) can be found on pages 34-35.

R-21-02

> Require all railroads to revise training and increase oversight to ensure that operating crews properly use restricted speeds. (R-21-02)

Information that addresses the requirements of 49 *U.S.C.* 1117(b), as applicable, can be found in section 2.3 Restricted Speed Accidents. Information supporting (b)(1) can be found in section 1.4 Events Leading Up to the Accident; information supporting (b)(2) can be found on page 36; (b)(3) is not applicable.