

BNSF Railway Roadway Worker Fatalities
Edgemont, South Dakota
January 17, 2017



Accident Report

NTSB/RAR-18/01
PB2018-101430



National
Transportation
Safety Board

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Notation 58116
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490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

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Abstract: On January 17, 2017, about 10:09 a.m. mountain standard time, BNSF Railway westbound train E DOLEBM0 01E, traveling at 35 mph, struck and killed two roadway workers, including the watchman/lookout. The accident occurred at milepost 477, on the Black Hills subdivision, in Edgemont, South Dakota. The three-member roadway work group had been cleaning snow and ice from the track switch on the main track to prepare for the movement of a train that was to have its air brake system tested in a stationary test on the main track. The crew of the striking train sounded the train horn and bell, and both members of the train crew applied emergency braking; however, there was no response from the roadway work group, and the train was unable to stop before reaching the work location. At the time of the accident, the sky was clear, the wind was calm, and reported temperatures ranged from 13° to 18°F. As a result of this investigation, the National Transportation Safety Board makes four safety recommendations to the Federal Railroad Administration and three safety recommendations to BNSF Railway.

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Abbreviations and Acronyms

Amtrak	National Railroad Passenger Corporation
BMWED	Brotherhood of Maintenance of Way Employees Division
BNSF	BNSF Railway
CFR	<i>Code of Federal Regulations</i>
COSO	Committee of Sponsoring Organizations of the Treadway Commission
Cutacross grade crossing	18 Cutacross Road highway/railroad grade crossing
CTC	centralized traffic control
FRA	Federal Railroad Administration
grade crossing	highway/railroad grade crossing
MOW	maintenance-of-way (roadway workers)
MP	milepost
NTSB	National Transportation Safety Board
RWIC	roadway worker-in-charge
RWP	roadway worker protection
SOTS	statement of on-track safety
TAW	train approach warning

Executive Summary

On January 17, 2017, about 10:09 a.m. mountain standard time, BNSF Railway westbound train E DOLEBM0 01E, traveling at 35 mph, struck and killed two roadway workers, including the watchman/lookout. The accident occurred at milepost 477, on the Black Hills subdivision, in Edgemont, South Dakota. The three-member roadway work group had been cleaning snow and ice from the track switch on the main track to prepare for the movement of a train that was to have its air brake system tested in a stationary test on the main track. The crew of the striking train sounded the train horn and bell, and both members of the train crew applied emergency braking; however, there was no response from the roadway work group, and the train was unable to stop before reaching the work location. At the time of the accident, the sky was clear, the wind was calm, and reported temperatures ranged from 13° to 18°F.

The accident occurred in the west leg of the Deadwood wye switch. Train movements on the main tracks in this area are controlled by centralized traffic control and governed by operating rules, general orders, timetable instructions, and the signal indications of an absolute block system.

The Black Hills subdivision consisted of two main tracks. The maximum operating speed was 35 mph between milepost 476.1 and milepost 477.0 on both main tracks. About 20 eastbound and 20 westbound trains per day operated on the main tracks through the accident area. There were multiple main tracks in this area with eastbound trains typically operating on main track 2 and westbound trains operating on main track 1.

This report addresses the following safety issues:

- **Train Approach Warning.** The investigation found that the sight distance at the Deadwood wye switch was inadequate for the safe use of the train approach warning method of on-track safety when using a single watchman/lookout. The watchman/lookout was not devoting his full attention to detecting approaching trains. In addition, in the year prior the accident, none of the members of the roadway work group were tested on the visual detection of trains.
- **Watchman/Lookout Equipment.** The investigation found that the watchman/lookout involved in this accident was not provided with the necessary equipment, such as a whistle, air horn, white disk, red flag, or fusee, to perform on-track safety duties, as required by federal regulations. The absence of on-track safety warning equipment likely allowed the watchman/lookout to engage in other work activities, rather than his assigned duty—watching for trains.
- **Roadway Worker-in-Charge to Roadway Work Group Job Briefings.** The investigation found that the job briefing conducted by the watchman/lookout and the other roadway workers in the work group fouling the track had incorrect information regarding the minimum-required sight distance and the required time to move to the predetermined place of safety.

The National Transportation Safety Board determines that the probable cause of the accident was the improper use of train approach warning by the BNSF Railway roadway work group to provide on-track safety. Contributing to the accident was incorrect information provided in the job briefing, including a miscalculated sight-distance assessment. Also contributing to the accident was the failure of BNSF Railway to provide the watchman/lookout with the necessary equipment to alert the work group of oncoming trains and equipment. Further contributing to the accident was the Federal Railroad Administration's inconsistent enforcement of federal regulations requiring that railroads equip watchman/lookouts.

1. Factual Information

1.1 The Accident

On January 17, 2017, about 10:09 a.m. mountain standard time, BNSF Railway (BNSF) westbound train E DOLEBM0 01E, traveling at 35 mph, struck and killed two roadway workers, including the watchman/lookout.¹ The accident occurred at milepost (MP) 477, on the Black Hills subdivision, in Edgemont, South Dakota. The three-member roadway work group had been cleaning snow and ice from the track switch on the main track to prepare for the movement of a train for an air brake system stationary test on the main track. The crew of the striking train sounded the train horn and bell, and both members of the train crew applied emergency braking; however, there was no response from the roadway work group, and the train was unable to stop before reaching the work location.² At the time of the accident, the sky was clear, the wind was calm, and reported temperatures ranged from 13° to 18°F.

The accident occurred in the west leg of the Deadwood wye switch. Train movements on the main tracks in this area were controlled by centralized traffic control (CTC) and governed by operating rules, general orders, timetable instructions, and the signal indications of an absolute block system (BNSF 2015).³

At the accident location, the Black Hills subdivision consisted of two main tracks. The accident occurred at one of the switches that allowed entry into the Deadwood wye track. Figure 1 shows the accident location (red star) and the three trains discussed in the report: the accident train is shown in black, the train on main track 2 is shown in blue, and the test train is shown in red.

¹ (a) All times in this report are mountain standard time. (b) Roadway work groups may also be referred to as maintenance-of-way work groups. (c) The watchman/lookout is designated by the roadway worker-in-charge (RWIC) and can be any member of the roadway worker work group who has received the proper training, which is offered annually.

² In the locomotive cab there were two emergency brake valves: one valve located at the engineer's control stand and one valve located at the conductor's work location.

³ A *wye switch* is a switch leading into a railroad wye. A *railroad wye* is a triangular arrangement of three tracks; this arrangement can be used to turn railroad equipment, including trains.

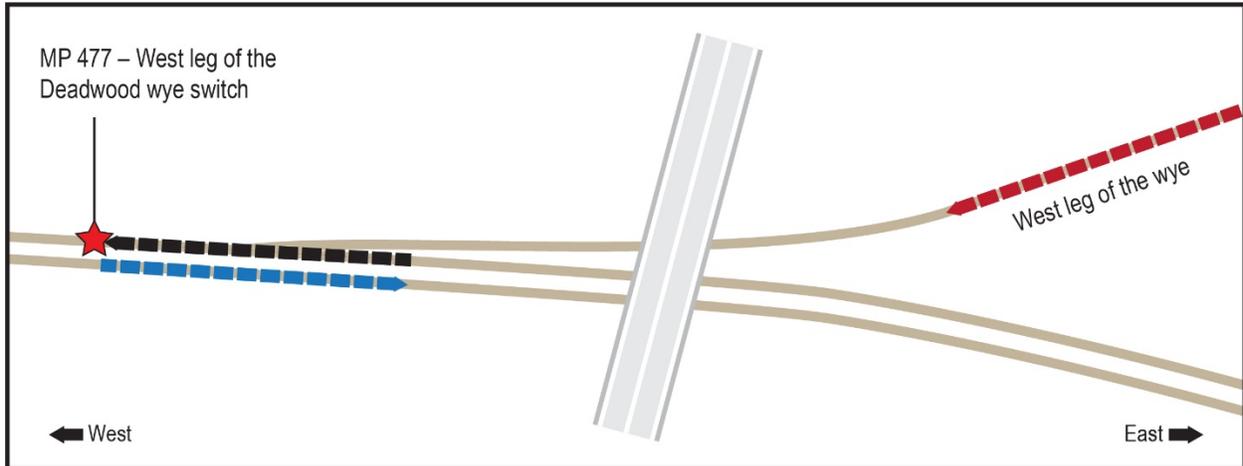


Figure 1. Overview of the accident location.

The maximum operating speed was 35 mph between MP 476.1 and MP 477.0 on both main tracks. About 20 eastbound and 20 westbound trains per day operated on the main tracks through the accident area, with eastbound trains typically operating on main track 2 and westbound trains operating on main track 1. (See figure 2.)



Figure 2. Photograph of the accident site.

1.2 The Investigation

1.2.1 Roadway Work Group

The roadway work group, consisting of a foreman, a truck driver, and a trackman, went on duty at Edgemont Yard at 7:30 a.m.⁴ After reporting for duty, a BNSF track inspector, acting on behalf of the BNSF roadmaster, instructed the crew to assist the test train that was occupying the Deadwood wye track. The roadway work group was to clear snow and ice from the highway-railroad grade crossings (grade crossing) so that train cars could be coupled.

The foreman and the truck driver traveled in the truck to the 18 Cutacross Road grade crossing (Cutacross grade crossing) on the west leg of the Deadwood wye track. The trackman traveled in a front-end loader that would be used during the snow removal. During the clearing work, the foreman and truck driver worked with the test train foreman and trainmaster removing snow and ice from the inside of the rails so that the car wheel flanges would stay on the rail as the train was coupled together. Meanwhile, the trackman, operating the front-end loader, cleaned the piles of snow from the ends of the crossings and between the section of cars. While they were working at the Cutacross grade crossing, a BNSF trainmaster told the foreman that the test train crew had difficulty operating the west leg wye switch and that the switch would need snow and ice removal. He also told the foreman about another switch that needed cleaning.

After the roadway work group finished at the Cutacross grade crossing, they traveled about 1 mile away to the railroad office. The trackman traveled in the front-end loader, while the foreman and the truck driver met him in the truck. The roadway work group then traveled in the truck to the west leg of the Deadwood wye switch on main track 1 and held a job briefing. During the job briefing, the roadway work group decided to use train approach warning (TAW) for its on-track safety method while cleaning the switch.⁵ The truck driver, referred to in the rest of this report as the watchman/lookout, completed a statement of on-track safety (SOTS) form, designating himself as the watchman/lookout for the roadway work group as shown in figure 3.

⁴ In most cases, the foreman is also the RWIC.

⁵ *Train approach warning* is a method of establishing on-track safety by warning roadway workers of the approach of trains in ample time for them to move to or remain in a place of safety.

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Lookout Responsibilities

Lookouts must adhere to the following:

- Be trained and rules qualified.
- Identify a place of safety where they and employees they are protecting can go when a train approaches.
- Communicate the place of safety to the other employees prior to the track being fouled.
- Devote their full attention to detecting the approach of trains and warning employees.
- Warn employees and have them positioned in a predetermined place of safety at least 15 seconds prior to the arrival of the train moving at maximum authorized speed as indicated in the Statement of On-Track Safety.
- Use a method to warn employees of the approach of a train or on-track equipment that:
 - Is distinctive, clear and unquestionable.
 - Does not require employees to be looking in any particular direction.
 - Can be detected by employees regardless of noise or work distractions
 - Is identified in the job safety briefing.

Employees who depend upon a lookout for protection must always remain in a position that allows them to receive warning communicated by the lookout.

STATEMENT OF ON-TRACK SAFETY

A lone worker using individual train detection or a lookout using train approach warning to establish on-track safety must complete this form prior to fouling a track.

To complete this form:

- Provide the following information:
 - Name of Lone Worker/Lookout: [REDACTED]
 - Date: 1-17-17 Division: RR
 - Subdivision: BH
 - Location: From MP 476.8 to MP 477.1
 - Designated Place of Safety: Truck
 - Method of Warning: Verbal
 - Time form completed: 1003
- In the table below, place an X in the box adjacent to the maximum authorized speed of trains at the location specified above. Observe the minimum required distance between the approaching train and the employee(s) when the place of safety has been reached.

Maximum Authorized Speed in MPH	Minimum Separation Upon Reaching Place of Safety		Maximum Authorized Speed in MPH	Minimum Separation Upon Reaching Place of Safety	
	X	Feet		X	Feet
5		110	50		1,100
10		220	55		1,210
15		330	60		1,320
20		440	65		1,430
25		550	70		1,540
30		660	75		1,650
35	X	770	80		1,760
40		880	85		1,870
45		990	90		1,980

Note: When the maximum authorized speed is not shown on the form, use the next higher speed.

Figure 3. The SOTS form completed by the watchman/lookout prior to the accident.

On the SOTS form, completed at 10:03 a.m., the watchman/lookout indicated that there was a minimum of 770 feet of sight distance needed to clear the track 15 seconds prior to the arrival of an approaching train. The statement also indicated that the method of warning of an approaching train would be verbal, and that the designated place of safety was the roadway work group truck. BNSF did not provide the watchman/lookout with any equipment—such as a whistle, air horn, white disk, red flag, lantern, or a fusee—to give audible or visual warning of approaching trains to other members of the roadway work group. This is discussed further in section 2.3 of this report.

After completing the SOTS, the roadway work group walked about 191 feet from the truck to the west leg of the wye switch and began cleaning the snow and ice from the switch points. While doing this task, the watchman/lookout held a long-handled tool in both hands and was positioned east of the other two roadway workers, near the north rail between the running rails.⁶

The foreman was using a backpack blower to remove snow and was just west of the watchman/lookout between the running rails. The trackman, who was working the furthest west, had stepped out of the gage of the track and started removing ice and snow using a short-handled

⁶ The front-end camera of the lead locomotive of the striking train recorded a long-handled tool in the hands of the watchman/lookout, and a short-handled shovel in the hands of the trackman. The investigation found a broken long-handled shovel on the ground at the accident scene, and a short-handled shovel on the ground near the switch.

shovel at the switch stand outside of the north rail. While the roadway work group was working on main track 1, on the west leg of the Deadwood wye switch, an eastbound train was operating on main track 2, adjacent to the accident location.

BNSF train E DOLEBM0 01E was traveling west around the 2° left-hand curve when the train crewmembers noticed the roadway work group fouling the track near the switch. The engineer sounded the horn and bell, but saw no response from the work group. Both train crewmembers applied the emergency brakes, but the train was unable to stop and struck the foreman and the watchman/lookout. At the time of the accident, only about 6 minutes had elapsed since the watchman/lookout completed the SOTS form. The surviving trackman said that he did not see or hear the train approaching, nor did he hear the horn or bell.

1.2.2 Striking Train

Westbound BNSF train E DOLEBM0 01E was an empty coal train, consisting of two westward-facing locomotives at the front of the train and two eastward-facing distributed power locomotives at the rear. The train had 135 empty cars and was 7,463 feet-long, including the four locomotives, and weighed 3,687 tons. E DOLEEM0 01E was operated by a two-person train crew. They boarded the train at MP 475.3, near the BNSF Edgemont Office Building, which they used as a crew change point, and that was less than 2 miles from the accident location. The train departed about 10:04 a.m.

1.2.3 Test Train

A BNSF test train was located on the Deadwood wye track at the time of the accident. The planned air brake system test included moving the train from the spur track onto the main line at MP 478 and performing a static test.⁷

In an interview with National Transportation Safety Board (NTSB) investigators, the conductor of the test train said that he had job briefings and discussions with the trainmaster, an engineer, and a foreman in the Edgemont crew office on the day of the accident.⁸ The test train crew received authority from the train dispatcher to move from the yard to the wye switch. At the entry switch to the wye track, the test train crew had to chip ice to throw the switch, a process that took between 45 minutes to 1 hour. The conductor told NTSB investigators that the switch “was frozen pretty good and it was hard to throw (operate). We actually ended up using the stand as a cheater pipe that the shovel’s on for a little bit.”⁹ He recalled that once they got the switch open and before they relocked it, he threw the switch once or twice to ensure that it was functional. He then said that it was at that point when the test train crew contacted the train dispatcher to relay that the locomotives were off the main track and on the wye track.

⁷ A *static test* is the testing of air brake propagation signals throughout the train set. It was to be conducted with instrumentation installed at various locations on the train, which was to remain stationary during the test.

⁸ Transcripts of interviews conducted by NTSB investigators can be found in the docket for this investigation: DCA17FR004.

⁹ A *cheater pipe* is a piece of hollow pipe that was inappropriately used to increase leverage to break ice to allow for the work group to align the switch. BNSF prohibits the use of this technique.



Figure 4. Accident switch and pieces of the long-handled shovel.

1.2.4 Roadway Worker Protection

Roadway workers who install, maintain, and inspect railroad tracks are often exposed to risk associated with working near moving equipment. There are several methods available to provide on-track safety to roadway workers when their duties require that they foul a track.¹⁰ Some work requires fouling tracks with equipment, disturbing the track, or working in locations where sight distance is limited and, therefore, requires the establishment of working limits. Working limits is an on-track safety measure which keeps trains, locomotives, or other on-track equipment away from roadway workers.¹¹ According to Title 49 *Code of Federal Regulations (CFR)* 214.7, “working limits” can be established through several methods, including exclusive

¹⁰ According to Title 49 *Code of Federal Regulations (CFR)* 214.7: (a) *On-track safety* means 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. (b) *Fouling a track* means the placement of an individual or an item of equipment in such proximity to a track that the individual or equipment could be struck by a moving train or on-track equipment, or in any case is within 4 feet of the field side of the near running rail.

¹¹ According to 49 *CFR* 214.7, *working limits* means a segment of track with definite boundaries established in accordance with this part upon which trains and engines may move only as authorized by the roadway worker having control over that defined segment of track.

track occupancy, inaccessible track, foul time, and train coordination. Circumstances—such as track characteristics, the railroad’s operating rules, and the way the trains are allowed to move on the specific track—determine which method should be used at a particular time. (*Federal Register*, 1996, 65959). Some work can be completed while trains and other on-track equipment are still operating over the tracks. According to 49 *CFR* 214.329, “roadway workers in a roadway work group who foul any track outside of working limits shall be given warning of approaching trains by one or more watchmen/lookouts.”

2. Safety Issues

2.1 Introduction

The NTSB identified the following safety concerns in the investigation of this accident: (1) improper use of TAW, (2) watchman/lookout performance and the lack of necessary equipment to provide on-track safety, and (3) inadequate roadway worker-in-charge (RWIC) to roadway work group job briefings.

2.2 Train Approach Warning

Based on an interview with the surviving member of the roadway work group, NTSB investigators determined that the roadway workers were using TAW as their method of on-track safety. During the assessment of the accident site, NTSB investigators determined that the sight distance was about 620 feet. A train traveling at 35 mph covers 51.3 feet per second. At that rate, the roadway work group would have had about 12 seconds from the time the train came into view until it arrived at the work location; this would not have allowed adequate time for the workers to get into the previously arranged place of safety. Additionally, the loud noise level at the work location, due to a moving train on an adjacent track and the use of a snow blower, likely degraded the roadway work group's ability to hear the approaching train. To comply with the regulations outlined in 49 *CFR* 214.329, a sight distance of about 1,280 feet was needed to allow for a roadway work group to clear to a previously arranged place of safety and be in that place of safety for the required 15 seconds before a train moving at the maximum speed authorized on that track can pass the location of the roadway work group. There was inadequate sight distance; therefore, working limits should have been established. Therefore, TAW was insufficient to use because it did not allow enough time to clear the track.

Periodically, railroad employees are tested on various aspects of their job to evaluate their ability to perform their jobs correctly and their knowledge of company rules and Federal Railroad Administration (FRA) regulations. This testing not only evaluates the worker's skills and overall ability to perform a task safely and correctly, it also reinforces compliance with rules. If workers expect to be observed and evaluated, they are more likely to follow rules and best practices. Table 1 shows the operational testing record of the roadway work group members in the year prior to the accident.

Table 1. Operations testing summary – January 17, 2016 – January 17, 2017.

Employee	Total Tests	Total Failures	Main Track Authorization Tests	Visual Detection of Trains Tests
Foreman	24	0	3	0
Truck Driver – Watchman/Lookout	24	0	3	0
Trackman	4	0	0	0

As the data in table 1 illustrates, none of the members of the roadway work group had been tested on the visual detection of trains in the year prior to the accident. The NTSB

concludes that BNSF did not perform operational testing of the roadway work group to reinforce compliance with railroad rules and FRA regulations regarding TAW. Therefore, the NTSB recommends that BNSF include evaluations on the visual detection of trains as a regular component of roadway work group employees' required operational testing.

Since the accident, BNSF completed a job aid to offer step-by-step instructions for watchmen/lookouts who are to foul a track. It provides steps for watchmen/lookouts to take to use TAW correctly. For additional information, see appendix D.

2.3 Watchman/Lookout Equipment

The watchman/lookout's sole responsibility is to look for approaching trains. According to the definition of watchman/lookout outlined in 49 *CFR* 214.7, watchmen/lookouts should be "properly equipped to provide visual and auditory warning such as whistle, air horn, white disk, red flag, lantern, fuse (*sic.*)"¹² However, in the June 10, 2016, preamble of 49 *CFR* 214, comments from the Brotherhood of Maintenance of Way Employes Division's (BMWED) expressed concern that some railroads did not provide watchmen/lookouts with any audible or visual warning devices to provide appropriate TAW (*Federal Register*, 2016, 37840).¹³ The comment urged the FRA to clarify in the final rule that the use of such audible and/or visible warning devices are mandatory to provide TAW under 49 *CFR* 214.329. The FRA concurred with the comments from BMWED.

Further the preamble stated:

Thus, FRA emphasizes that under the existing RWP [roadway worker protection] regulation, a railroad must properly equip a watchman/lookout with the equipment specified by the railroad's on-track safety program to properly communicate a warning. Except in limited circumstances (e.g., a watchman/lookout assigned to provide train approach warning for a single welder and who is located immediately next to the welder to provide a warning), if a railroad does not provide equipment with the specified auditory or visual warning capabilities to the roadway workers a watchman/lookout is protecting, the railroad is in violation of § 214.329. If an on-track safety program fails to specify the "requisite equipment necessary" for a watchman/lookout to provide on-track safety for a roadway work group, the program also is not compliant with 214.

The TAW method of on-track safety relies on a vigilant watchman/lookout to provide a timely, distinct, and detectable warning of an approaching train or other on-track equipment. The method of warning must not require the warned employees to look in a particular direction and must be perceivable by the warned employees regardless of noise or distractions of the work. Watchman/lookout equipment, such as a whistle, air horn, white disk, red flag, lantern, or fusee are necessary to properly implement TAW. Moreover, the use of warning equipment, particularly

¹² Although the 2016 version of 49 *CFR* 214.7 currently uses the term "fuse", earlier versions used the term "fusee". Therefore, we believe the use of the word "fuse" is an error.

¹³ BMWED spells the word "Employes" in its name with one e. Therefore, we are using that spelling in this report.

continuously hand-held devices, such as flags, disks, and horns, can facilitate attentional focus on task duties and serves to formalize and validate the on-track safety process to other members of the roadway work group at that location (Hartson 2003), (Gibson 1977), (Norman 1999).

On April 6, 2017, NTSB investigators interviewed an FRA headquarters track specialist responsible for roadway worker protection (RWP) and roadway maintenance machines.¹⁴ During this interview, the FRA track specialist said that the watchman/lookout's duty is to exclusively look out for approaching trains or on-track equipment.¹⁵ He added that the regulation discusses some of the possible equipment that a watchman/lookout could use while working, but he acknowledges that the list was not exclusive.

When asked if BNSF's roadway worker protection program has been reviewed by the FRA, in compliance with the FRA regulation, the FRA track specialist said that the program was reviewed when it was initiated, but he was not sure if it had been reviewed since then.

In a June 29, 2017, response to a NTSB request for information, the FRA reaffirmed its position that railroads should provide the necessary equipment for watchmen/lookouts to safely perform their jobs. "It is intended that a railroad's on-track safety program would specify the means to be used by watchmen/lookouts to communicate a warning, and that they be equipped according to that provision," the FRA said.¹⁶

NTSB investigators asked the FRA for all documents related to its postaccident audits of BNSF's RWP programs for the time period of January 1, 2017, through April 6, 2017. The FRA responded, "FRA's investigation is ongoing at this time. With that said, following the Edgemont accident, as part of its investigation FRA reviewed the watchman/lookout provisions of BNSF's On-Track Safety Program and noted no exceptions."¹⁷ On August 8, 2018, a representative from the FRA told NTSB investigators that there has been no change to the FRA position.¹⁸

In light of the information gathered from this investigation, the NTSB concludes that the FRA's equipment requirement for watchmen/lookouts is inconsistent and violates Title 49 *Code of Federal Regulations (CFR)* 214.329. Railroads must ensure that watchmen/lookouts have the tools necessary to warn work crews of approaching trains. Therefore, the NTSB recommends that the FRA review, and modify if necessary, its current inspection guidance regarding watchman/lookout equipment to verify that it requires railroads to provide the necessary equipment for a watchman/lookout to notify a roadway work group of approaching trains and that this guidance accurately reflects the definition outlined in 49 *CFR* 214.7. In addition, the NTSB recommends that the FRA review railroads' on-track safety programs to determine if the necessary equipment is required and provided for a watchman/lookout to notify a roadway work group of approaching trains. If deficiencies are discovered, use enforcement options to encourage compliance.

¹⁴ Transcripts of interviews conducted by NTSB investigators can be found in the docket for this investigation: DCA17FR004.

¹⁵ NTSB Docket DCA17FR004, "Interview with FRA Track Specialist".

¹⁶ E-mail from a representative of FRA to the NTSB in response to written questions, June 29, 2017.

¹⁷ E-mail from a representative of FRA to the NTSB in response to written questions, June 29, 2017.

¹⁸ E-mail from a representative of FRA to the NTSB in response to written questions, August 8, 2018.

In addition, the NTSB concludes that BNSF did not provide the appropriate equipment to its watchmen/lookouts because it was not required in its on-track safety program. Therefore, the NTSB recommends that BNSF revise its on-track safety program to include the proper equipment for watchmen/lookouts to provide TAW for roadway work groups. Furthermore, the NTSB concludes that the FRA's evaluation of BNSF's on-track safety program was erroneous because the program did not specify any watchman/lookout equipment to provide visual or auditory warning, as mandated by federal regulations. Therefore, the NTSB recommends that the FRA revise its guidance for inspectors regarding required watchman/lookout equipment and procedures, train all of its inspectors on the revised guidance, and audit subsequent inspections to verify adherence to the specifications outlined in 49 *CFR* 214.

2.4 Roadway Worker-in-Charge to Roadway Work Group Job Briefings

Chapter 3 of the FRA's *Track and Rail and Infrastructure Integrity Compliance Manual Volume III Railroad Workplace Safety*, provides guidance on RWP. The document explains the RWP rule, which is based on five fundamental safety principles:

1. A person who is not fouling a track will not be struck by a train.
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 knows either that
 - a. No train will arrive or
 - b. The person on the track will be able to move to a place of safety before a train arrives.
4. Each roadway worker bears the ultimate responsibility for his own on-track safety.
5. Each employer is responsible for providing the means for achieving on-track safety to each roadway worker employee (FRA 2017).

Chapter 3, "Roadway Worker Protection" of the FRA's *Track and Rail and Infrastructure Integrity Compliance Manual*, Volume III, Railroad Workplace Safety, provides the railroad industry with interpretations of and guidance on the railroad workplace safety regulations. The compliance manual regarding 49 *CFR* 214.315 stresses four points for roadway work group job briefings:

- (a) When an employer assigns duties to a roadway worker that call for that employee to foul a track, the employer shall provide the employee with a job briefing that includes information on the means by which on-track safety is to be provided, and instruction on the on-track safety procedures to be followed.

(b) A job briefing for on-track safety shall be deemed complete only after the roadway worker has acknowledged understanding the on-track safety procedures and instructions presented.

(c) Every roadway work group whose duties require fouling a track shall have one roadway worker designated by the employer [RWIC] to provide on-track safety for all members of the group. The designated person [RWIC] shall be qualified under the rules of the railroad that conducts train operations on those tracks to provide the protection necessary for on-track safety of each individual in the group. The responsible person [RWIC] may be designated generally, or specifically for a particular work situation.

(d) Before any member of a roadway work group fouls a track, the designated person providing on-track safety for the group under paragraph (c) of this section [RWIC] shall inform each roadway worker of the on-track safety procedures to be used and followed during the performance of the work at that time and location. Each roadway worker shall again be so informed at any time the on-track safety procedures change during the work period. Such information shall be given to all roadway workers affected before the change is effective, except in cases of emergency. Any roadway workers who, because of an emergency, cannot be notified in advance shall be immediately warned to leave the fouling space and shall not return to the fouling space until on-track safety is re-established (FRA 2017).

Based on the interview with the surviving roadway worker, NTSB investigators determined that the on-track safety job briefing was incomplete. The information given regarding the required elements of the use of TAW were incorrect, such as:

- the correct sight distance;
- sufficient time to clear to a place a safety;
- the means used by the watchman/lookout to communicate a train approach.

The surviving roadway worker stated in an interview with NTSB investigators that the watchman/lookout said, "I'll fill one of these out," referring to the SOTS.

According to 49 *CFR* 214.311, to protect roadway workers, railroad supervisors (referred to in the regulation as employers) are responsible for the following:

(a) Each employer is responsible for the understanding and compliance by its employees [roadway workers] with its rules and the requirements of this part.

(b) Each employer shall guarantee each employee [roadway worker] the absolute right to challenge in good faith whether the on-track safety procedures to be applied at the job location comply with the rules of the operating railroad, and to remain clear of the track until the challenge is resolved.

- (c) Each employer shall have in place a written procedure to achieve prompt and equitable resolution of challenges made in accordance with §§214.311(b) and 214.313(d).

The responsibilities for the individual roadway workers in this scenario, as outlined in 49 *CFR* 214.313:

- (a) Each roadway worker is responsible for following the on-track safety rules of the railroad upon which the roadway worker is located.
- (b) A roadway worker shall not foul a track except when necessary for the performance of duty.
- (c) Each roadway worker is responsible to ascertain that on-track safety is being provided before fouling a track.
- (d) Each roadway worker may refuse any directive to violate an on-track safety rule, and shall inform the employer in accordance with § 214.311 whenever the roadway worker makes a good faith determination that on-track safety provisions to be applied at the job location do not comply with the rules of the operating railroad.

Based on the interview with the surviving roadway worker, NTSB investigators determined that the job briefing was incorrect, and did not allow the roadway work group to properly access the work location to determine if TAW was an adequate form of on-track safety. In addition, no member of the roadway work group initiated a good faith challenge to question the inaccurate job briefing.

The NTSB concludes that the job briefing performed by the watchman/lookout did not adhere to federal regulations, as outlined in 49 *CFR* 214.313. Therefore, the NTSB recommends that BNSF provide instruction for on-track safety procedures and conduct operational testing for RWIC personnel on their knowledge of roadway work group job briefing procedures to ensure that they know to include information on how on-track safety is to be provided when a roadway worker will be fouling a track.

2.5 Noncontributing Factors

The following were not factors in the accident:¹⁹

- Use of portable electronic devices: The investigation determined that cell phone usage was not a factor in this accident.
- Roadway worker employee training: The investigation determined that the training that was provided to the roadway workers was adequate.

¹⁹ For additional information, please see the docket for NTSB accident DCA17FR004.

- Impairment due to drugs or alcohol: Following the accident, in compliance with federal regulations, specimens obtained were tested for the presence of drugs or alcohol. Based on these results, impairment due to drugs or alcohol was eliminated as a factor in the accident.
- Fatigue: A 72-hour work/rest history was obtained for all four crewmembers of train A61. No evidence of fatigue was found.
- Train operations: The investigation took no exception to the operation of the striking train.
- Train equipment: The investigation determined that all of the train's systems functioned as designed.
- Track and engineering: The conditions of the track did not contribute to this accident.
- Signal equipment: The train dispatching activities were appropriate in the use of the signal system to coordinate train movements. The signal system was operating as designed and did not contribute to the accident.
- Emergency response: Emergency services responded to the scene. NTSB investigators took no exception to the emergency response to this accident.

3. Previous Accidents

3.1 Previous Board Action

3.1.1 NTSB Special Investigation Report on Railroad and Rail Transit Roadway Protection

During 2013, 11 railroad roadway workers died while doing their jobs, representing the largest number of railroad roadway workers killed while on duty in 1 year since 1995, when 12 died (FRA 2014). Also, in 2013, four rail transit roadway workers died. The NTSB published a special investigation report describing its investigation of these 15 deaths. The report identifies and discusses the circumstances of these deaths, which included falls from bridges, incidents involving bucket lifts, strikes by moving equipment, and natural hazards, including a mudslide. The report documented issues with improper or incomplete job briefings as a contributing factor in many accidents (NTSB 2014).

3.1.2 NTSB Safety Alert 066

On July 31, 2017, the NTSB issued *Watchman/Lookout: Your coworkers depend on you*, Safety Alert 066, warning rail workers of the risks of working on tracks using only a watchman/lookout to provide TAW (NTSB 2017a). The safety alert was distributed to the class I railroads, the Brotherhood of Railroad Signalmen, and BMWED.

Safety Alert 066 was prompted, in part, by this accident. The alert was issued to (1) highlight the hazards involved in the use of TAW as a form of on-track safety for roadway work groups and (2) heighten awareness of these hazards by the roadway workers who depend on this form of on-track safety.

3.1.3 Chester, Pennsylvania, Accident Investigation

On April 3, 2016, about 7:50 a.m. eastern daylight time, southbound National Railroad Passenger Corporation (Amtrak) train 89 struck a backhoe with a worker inside at MP 15.7 near Chester, Pennsylvania. The train was authorized to operate on main track 3 at the maximum authorized speed of 110 mph. Beginning on the morning of April 1, Amtrak had scheduled track-bed restoration—ballast vacuuming—at MP 15.7 on track 2 on the Philadelphia to Washington Line. Track 2 had to be taken out of service between control points Baldwin (MP 11.7) and Hook (MP 16.8) for the 55-hour duration of the project. As train 89 approached MP 15.7, the locomotive engineer saw equipment and workers on and near track 3 and initiated an emergency brake application. The train speed was 106 mph before the emergency brake application and 99 mph when it struck the backhoe. Two roadway workers were killed, and 39 other people were injured. Amtrak estimated property damages to be \$2.5 million (NTSB 2017b).

Some of the safety issues identified in the course of this investigation are similar to those the NTSB investigators found at Edgemont. Although the watchman/lookout in Chester had some safety equipment, Amtrak did not provide the members of the work group with

supplemental shunting devices that they could have used to prevent the accident. The NTSB determined in its investigation of the accident that “the inadequate and inconsistent use of supplemental shunting devices by Amtrak engineering personnel effectively defeated the roadway worker protection component of Amtrak’s Advanced Civil Speed Enforcement System and thereby placed maintenance-of-way employees, equipment, and the traveling public at greater risk of harm (NTSB 2017b).”

NTSB investigators also found the lack of a job briefing to be a significant safety issue in the Chester accident. The day foreman did not conduct the FRA-required job briefing before the shift began. The job briefing should have included the form of protection from intrusions onto out-of-service tracks that would be used during the upcoming shift. The track protection information included in the job briefing would have made the work crew aware of the presence or absence of track protection and would have enabled them to question the absence of that protection if the protection plan was not followed. As a result of this investigation, the NTSB concluded that “had the day foreman conducted a thorough job briefing for all workers on the day shift, including the supervisor, before the work began, foul time protection or the lack thereof and which foreman had the foul time likely would have been discussed and then rectified or mitigated by removal of the backhoe from track 3 (NTSB 2017b).”

3.2 Federal Railroad Administration Roadway Worker Protection Audit

In June 2008, the FRA initiated a series of nationwide audits on RWP based on an increase in roadway worker fatalities. From June through December 2008, FRA conducted 1,895 unannounced audits and identified three times the number of safety-critical defects than they found during normal track inspections. According to the FRA, incomplete or missing job briefings and the failure to provide on-track safety were common issues they found during the course of the audit.²⁰

Table 2 shows the number of FRA-reported on-duty fatalities caused by on-track equipment strikes. It lists fatalities for all employee types, as well as fatalities for roadway workers (referred to in the table as MOW).

Table 2. FRA on-duty fatalities caused by on-track equipment strikes.

Fatalities	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
All	3	9	9	2	0	5	2	3	2	4	5	44
MOW	3	5	5	0	0	2	2	2	1	4	5	29
% MOW	100	55.6	55.6	0	0	40.0	100	66.7	50.0	100.0	100.0	65.9

As this table illustrates, the number of on-duty fatalities caused by on-track equipment strikes declined in the years immediately following the FRA audit. However, as time passed, and the number of unannounced inspections waned, the number of fatalities began to trend upward again. This upward trend shows that audits and monitoring rules compliance are critical

²⁰ E-mail from the FRA Office of Safety Analysis and Office of Railroad Safety executive officer to the NTSB, received April 16, 2018.

risk-management activities to ensure that controls are effective (Committee of Sponsoring Organizations of the Treadway Commission [COSO] 2009). The NTSB concludes that the FRA's 2008 unannounced audit of railroads' RWP programs identified safety-critical defects, deterred rules violations, and encouraged safe practices, likely contributing to the reduction of the number of roadway worker fatalities. Furthermore, the NTSB concludes that the possibility of an unannounced FRA audit led to railroads making compliance with RWP regulations a higher priority. Therefore, the NTSB recommends that FRA modify the National Inspection Plan to require periodic unannounced inspections for RWP regulation compliance.

4. Conclusions

4.1 Findings

1. BNSF Railroad did not perform operational testing of the roadway work group to reinforce compliance with railroad rules and Federal Railroad Administration regulations regarding train approach warning.
2. The Federal Railroad Administration's equipment requirement for watchmen/lookouts is inconsistent and violates Title 49 *Code of Federal Regulations* 214.329. Railroads must ensure that watchmen/lookouts have the tools necessary to warn work crews of approaching trains.
3. BNSF Railroad did not provide the appropriate equipment to its watchmen/lookouts because it was not required in its on-track safety program.
4. The Federal Railroad Administration's evaluation of BNSF Railroad's on-track safety program was erroneous because the program did not specify any watchman/lookout equipment to provide visual or auditory warning, as mandated by federal regulations.
5. The job briefing performed by the watchman/lookout did not adhere to federal regulations, as outlined in Title 49 *Code of Federal Regulations* 214.313.
6. The Federal Railroad Administration's 2008 unannounced audit of railroads' roadway worker protection programs identified safety-critical defects, deterred rules violations, and encouraged safe practices, likely contributing to the reduction of the number of roadway worker fatalities.
7. The possibility of an unannounced Federal Railroad Administration audit led to railroads making compliance with roadway worker protection regulations a higher priority.

4.2 Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the improper use of train approach warning by the BNSF Railway roadway work group to provide on-track safety. Contributing to the accident was incorrect information provided in the job briefing, including a miscalculated sight-distance assessment. Also contributing to the accident was the failure of BNSF Railway to provide the watchman/lookout with the necessary equipment to alert the work group of oncoming trains and equipment. Further contributing to the accident was the Federal Railroad Administration's inconsistent enforcement of federal regulations requiring that railroads equip watchmen/lookouts.

5. Recommendations

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

To the Federal Railroad Administration:

Review, and modify if necessary, your current inspection guidance regarding watchman/lookout equipment to verify that it requires railroads to provide the necessary equipment for a watchman/lookout to notify a roadway work group of approaching trains and that this accurately reflects the definition contained in Title 49 *Code of Federal Regulations* 214.7. (R-18-16)

Review railroads' on-track safety programs to determine if the necessary equipment is required and provided for a watchman/lookout to notify roadway work groups of approaching trains. If deficiencies are discovered, use enforcement options to encourage compliance. (R-18-17)

Revise your guidance for inspectors regarding required watchman/lookout equipment and procedures, train all of your inspectors on the revised guidance, and audit subsequent inspections to verify adherence to the specifications outlined in Title 49 *Code of Federal Regulations* 214. (R-18-18)

Modify the National Inspection Plan to require periodic unannounced inspections for roadway worker protection regulation compliance. (R-18-19)

To BNSF Railway:

Include evaluations on the visual detection of trains as a regular component of roadway work group employees' required operational testing. (R-18-20)

Revise your on-track safety program to include the proper equipment for watchmen/lookouts to provide train approach warning for roadway work groups. (R-18-21)

Provide instruction for on-track safety procedures and conduct operational testing for roadway worker-in-charge personnel on their knowledge of roadway work group job briefing procedures to ensure that they know to include information on how on-track safety is to be provided when a roadway worker will be fouling a track. (R-18-22)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

ROBERT L. SUMWALT, III
Chairman

EARL F. WEENER
Member

BRUCE LANDSBERG
Vice Chairman

T. BELLA DINH-ZARR
Member

JENNIFER HOMENDY
Member

Adopted: August 27, 2018

6. Appendix

6.1 Appendix A. Investigation

The National Transportation Safety Board (NTSB) was notified on January 17, 2017, of the accident in which two roadway workers were struck and killed by a BNSF Railway (BNSF) train. The NTSB launched a team to investigate track, signals and train control, railroad operations, mechanical/equipment, event/data recorders, human performance, and an investigator-in-charge.

The parties to the investigation include Federal Railroad Administration (FRA), BNSF, Brotherhood of Locomotive Engineers and Trainmen, International Association of Sheet Metal, Air, Rail, and Transportation Workers – Transportation Division, and the Brotherhood of Maintenance of Way Employees Division.

6.2 Appendix B. BNSF Watchman/Lookout Operating Rules

BNSF Operating Rule 6.3.3 B. Lookouts states the following:

Lookouts must complete the form entitled “Statement of On-Track Safety” before any member of the work group fouls the track. The completed form must remain in the lookout’s possession while a work group performs minor work or routine inspection and on-track safety is established using a lookout.

Lookouts must adhere to the following:

- Be trained and rules qualified
- Identify a place of safety where they and employees in their work group can go when a train or engine approaches
- Communicate the place of safety to all employees in the work group before fouling the track
- Devote their full attention to detecting the approach of trains and engines and warning employees
- Warn employees and have them positioned in a predetermined place of safety at least 15 seconds before the arrival of the train or engine moving at maximum authorized speed as indicated in the Statement of On-Track Safety
- Use a method to warn employees of the approach of a train, engine or on-track equipment that:
 - Is distinctive, clear, and unquestionable
 - Does not require employees to be looking in any particular direction
 - Can be detected by employees regardless of noise or work distractions
 - Is identified in the job safety briefing
- Employees who depend upon a lookout for on-track safety must always remain in a position that allows them to receive warnings communicated by the lookout (BNSF 2015b).

6.3 Appendix C. FRA Watchman/Lookout Regulations

Federal regulations, Title 49 *Code of Federal Regulations (CFR)* 214.7, governing roadway workers using train approach warning defines a watchman/lookout as follows:

Watchman/lookout means an employee who has been trained and qualified to provide warning to roadway workers of approaching trains or on-track equipment. Watchmen/lookouts shall be properly equipped to provide visual and auditory warning such as whistle, air horn, white disk, red flag, lantern, fuse (*sic.*). A watchman/lookout's sole duty is to look out for approaching trains/on-track equipment and provide at least fifteen seconds advanced warning to employees before arrival of trains/on-track equipment.

The requirements in Title 49 *CFR* 214.329 are as follows:

Roadway workers in a roadway work group who foul any track outside of working limits shall be given warning of approaching trains by one or more watchmen/lookouts in accordance with the following provisions:

(a) Train approach warning shall be given in sufficient time to enable each roadway worker to move to and occupy a previously arranged place of safety not less than 15 seconds before a train moving at the maximum authorized speed on that track can pass the location of the roadway worker. The place of safety to be occupied upon the approach of a train may not be on a track, unless working limits are established on that track.

(b) Watchmen/lookouts assigned to provide train approach warning shall devote full attention to detecting the approach of trains and communicating a warning thereof, and shall not be assigned any other duties while functioning as watchmen/lookouts.

(c) The means used by a watchman/lookout to communicate a train approach warning shall be distinctive and shall clearly signify to all recipients of the warning that a train or other on-track equipment is approaching.

(d) Every roadway worker who depends upon train approach warning for on-track safety shall maintain a position that will enable him or her to receive a train approach warning communicated by a watchman/lookout at any time while on-track safety is provided by train approach warning.

(e) Watchmen/lookouts shall communicate train approach warnings by a means that does not require a warned employee to be looking in any particular direction at the time of the warning, and that can be detected by the warned employee regardless of noise or distraction of work.

(f) Every roadway worker who is assigned the duties of a watchman/lookout shall first be trained, qualified and designated in writing by the employer to do so in accordance with the provisions of §214.349.

(g) Every watchman/lookout shall be provided by the employer with the equipment necessary for compliance with the on-track safety duties which the watchman/lookout will perform.

6.4 Appendix D. BNSF Postaccident Action

To assist roadway workers when deciding if the use of train approach warning or individual train detection as methods of on-track safety is appropriate, BNSF completed a lone worker/lookout (watchman/lookout) assessment aid. This document is available to roadway workers whose duties require them to foul tracks and will be used in BNSF’s annual training for roadway workers. (See figure 5).

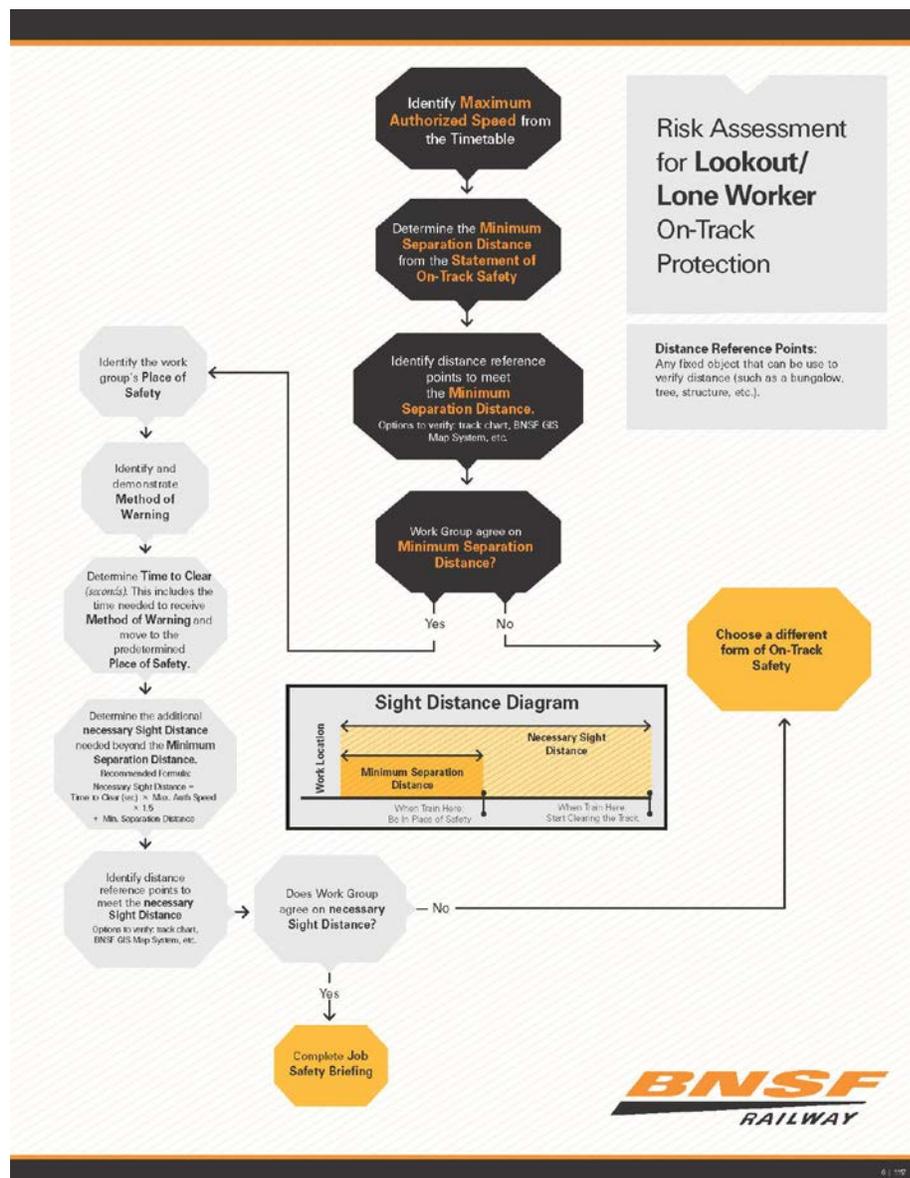


Figure 5. BNSF's Risk Assessment for Lookout/Lone Worker On-Track Protection job aid.

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