

Special Investigation Report on Railroad and Rail Transit Roadway Worker Protection



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**National
Transportation
Safety Board**

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

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Abstract: 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. Also in 2013, four rail transit roadway workers died. This special investigation report describes the results of a National Transportation Safety Board (NTSB) 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 also identifies the following recurring safety issues: job briefings, regulation and safety oversight, the Fatality Analysis of Maintenance-of-Way Employees and Signalmen Committee, and safety culture and safety management systems. Safety recommendations to the Federal Railroad Administration, the Federal Transit Administration, the Occupational Safety and Health Administration, and the Fatality Analysis of Maintenance-of-Way Employees and Signalmen Committee are included.

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Acronyms and Abbreviations

APTA	American Public Transportation Association
BART	San Francisco Bay Area Rapid Transit District
B&B	Bridge and Building
BMWED	Brotherhood of Maintenance of Way Employees Division
BNSF	BNSF Railway
CAL/OSHA	California Occupational Safety and Health Administration
Canadian Pacific	Canadian Pacific Railway
CFR	<i>Code of Federal Regulations</i>
CP	control point
CSX	CSX Transportation
EIC	employee in charge
EEPS	Enhanced Employee Protection System
ESS	east siding switch yes
FAMES	Fatality Analysis of Maintenance-of-Way Employees and Signalmen
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
helper	welder helper (Trevose)
ICAO	International Civil Aviation Organization
MAP-21	Moving Ahead for Progress in the 21st Century Act of 2012
MBTA	Massachusetts Bay Transportation Authority
Metra	Northeast Illinois Regional Commuter Rail Corporation
Metro-North	Metro-North Railroad
MOA	memorandum of agreement
MOU	memorandum of understanding
MP	milepost
NS	Norfolk Southern Railway
NTSB	National Transportation Safety Board
operator 1	CSX equipment operator (Bradner)
OSH Act	Occupational Safety and Health Act of 1970

OSHA	Occupational Safety and Health Administration
RTC	rail traffic controller
RWIC	roadway worker in charge
SSOA	state safety oversight agency
TCRP	Transit Cooperative Research Program
trainee	operator trainee operating the train (BART)
UP	Union Pacific Railroad
WMATA	Washington Metropolitan Area Transit Authority
WMATA crew	WMATA track and structure maintenance production crew
WSS	west siding switch

1. Introduction

As defined by Title 49 *Code of Federal Regulations* (CFR) 214.7, *roadway worker* means

any employee of a railroad, or of a contractor to 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 this section.¹

Throughout this special investigation report, the term roadway worker will mean the definition above as well as all engineering employees who are on or near the tracks, regardless of their duties.²

Railroad and rail transit roadway workers are subject to on-the-job risks and hazards markedly different from those faced by other railroad employees. The jobs of railroad engineers and conductors include risks primarily related to moving trains—derailments, collisions with other trains; the jobs of roadway workers involve hazards that include moving rolling stock and other equipment and vehicles, as well as falls, electrocution, and natural hazards.

During 2013, 11 railroad roadway workers died while doing their jobs, which is nearly 80 percent of the total number of railroad employees who died in 2013 (14). (See figure 1.) This represents the largest number of railroad roadway workers killed while on duty in 1 year since 1995, when 12 died (FRA 2014c). Also in 2013, four rail transit roadway workers died. (See figure 2.) Figure 2 illustrates the number of employee fatalities that occurred on rail transit properties between 2008 and 2013 and notes an increase in fatal accidents over previous years. The types of accidents in which roadway workers lost their lives in 2013 included falls from bridges, incidents involving bucket lifts, and a mudslide, as well as strikes by moving equipment.³ The number of roadway worker deaths in 2013, the findings from investigations of those deaths, and the increasing number of these fatalities prompted the National Transportation Safety Board (NTSB) to initiate this special investigation to identify safety issues facing roadway workers and to recommend actions to address these issues.

¹ *Roadway* means the strip of land on which railroad tracks are constructed. A roadway also may be referred to as right-of-way and wayside; As defined by 49 CFR 214.7, *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.

² Roadway workers are also referred to as maintenance-of-way workers.

³ Bucket lifts are also known as aerial lifts, telescopic boom lifts, and manlifts.

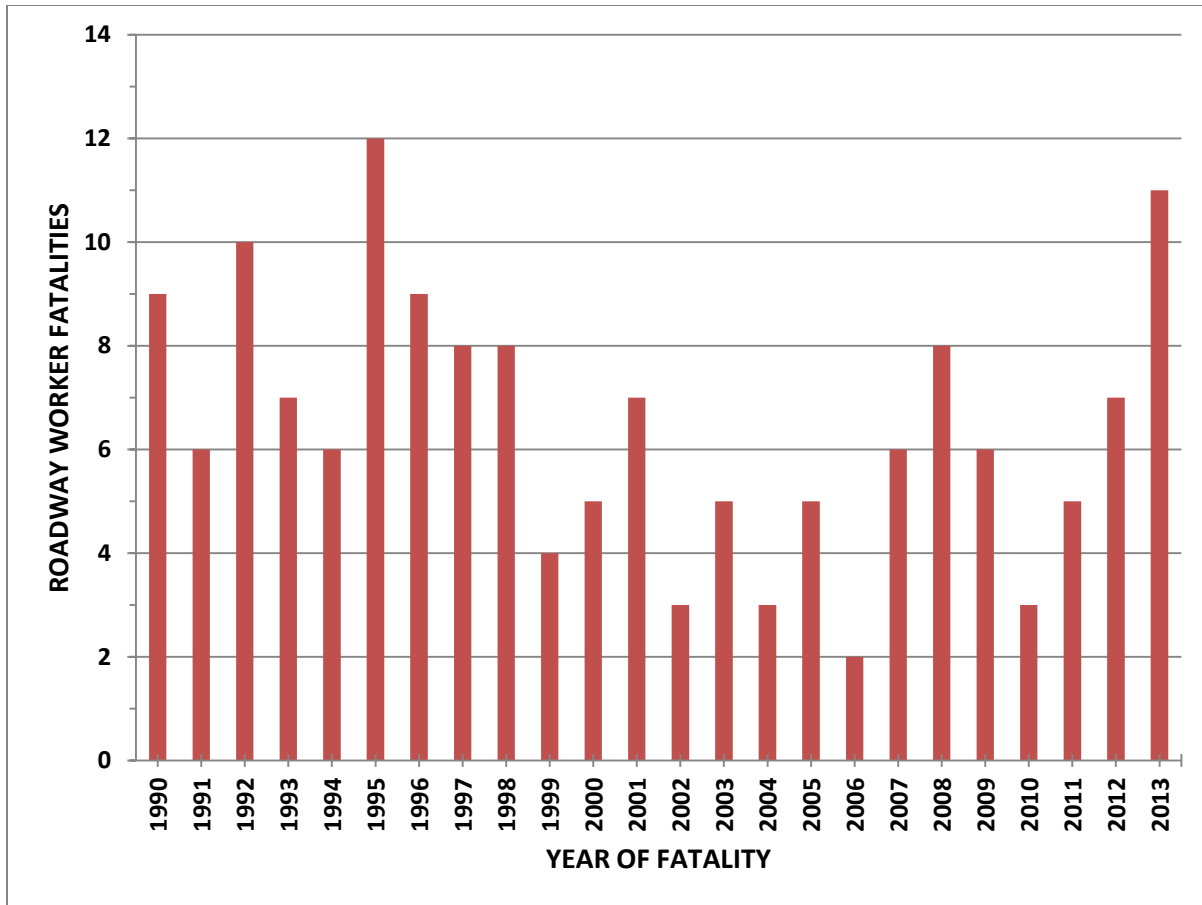


Figure 1. Railroad roadway worker fatalities annually from 1990 through 2013 as reported to FRA.

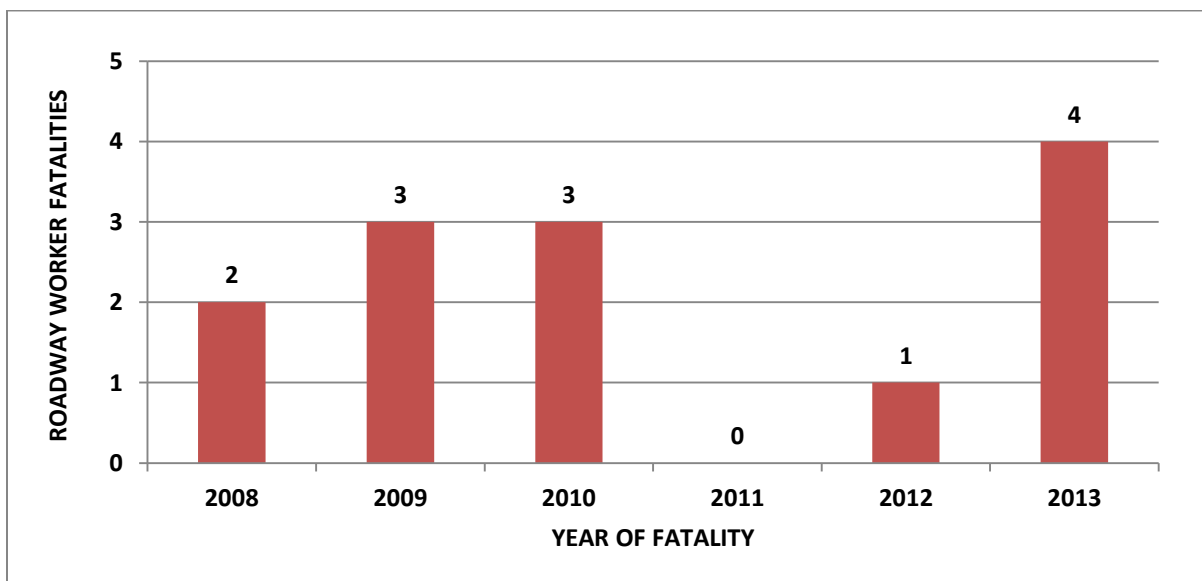


Figure 2. Rail transit roadway worker fatalities annually from 2008 through 2013 as reported to FTA.

The NTSB examined the roadway worker fatalities reported for 2013. For some accidents, the NTSB performed limited investigations either on scene or through reviews of the accident records. For other accidents, the NTSB used information prepared by other investigative agencies, including the Federal Railroad Administration (FRA), the Federal Transit Administration (FTA), and the Occupational Safety and Health Administration (OSHA), as well as railroads and rail transit agencies.⁴ The purpose of these NTSB examinations was to identify the circumstances in which the accidents occurred and to discover any deficiencies or limitations—in operating procedures and regulations or adherence to those procedures and regulations—that suggested causes and remedies.

Of the roadway worker fatalities in 2013, 11 resulted from 11 accidents on railroads regulated by the FRA, and 4 resulted from 3 accidents on rail transit properties with FTA oversight. Figure 1 shows that the number of railroad worker fatalities has fluctuated but has averaged about 6.4 per year from 1990 to 2013. Because roadway worker fatalities have been increasing over the past 4 years, careful examination of the causes of these recent fatal accidents is warranted.

⁴ Title 49 CFR Part 659, Rail Fixed Guideway Systems; State Safety Oversight: designated state safety oversight agencies are responsible for investigating accidents meeting prescribed criteria; OSHA has safety regulations that apply to employees of some rail transit agencies through approved state plans developed by 25 states, the Virgin Islands, and Puerto Rico.

2. Roadway Worker Fatalities in 2013

The 14 accidents that caused the 15 roadway worker fatalities in 2013 can be divided into five categories based on the circumstances of the accidents:⁵

- Natural hazards
- Falls
- Bucket lifts
- Train strikes
- Other accidents

Selected details about these accidents are shown in table 1; the accident locations are illustrated in figure 3. The accidents in each category are described in the following subsections, along with discussions of what they reveal about roadway worker protection, safety awareness, and actions needed to improve these.

⁵ One of the rail transit accidents resulted in two fatalities.

Table 1. Roadway worker fatal accidents in 2013.

Location	Date	Fatalities	Injuries	Circumstances	Railroad/ Transit Company	Regulatory Jurisdiction/ Oversight
NATURAL HAZARDS						
Old Fort, NC	05/06	1	0	mudslide	Norfolk Southern Railway	FRA OSHA (state)
Treose, PA	07/14	1	0	heat stroke	CSX Transportation	FRA OSHA (federal)
FALLS						
Philadelphia, PA	07/15	1	0	fell from bridge, unsecured grating	CSX Transportation	FRA OSHA (federal)
Marianna, FL	10/29	1	0	fell from bridge, unsecured grating	CSX Transportation	FRA OSHA (federal)
New York City, NY	04/24	1	0	fell into path of train	New York City Transit	FTA (New York Public Transportation Safety Board) OSHA (state)
BUCKET LIFTS						
Harpursville, NY	08/26	1	0	electrocuted when boom touched live wire	Canadian Pacific Railway	FRA OSHA (federal)
Mathis, TX	09/04	1	1	aerial lift vehicle overturned	Union Pacific Railroad	FRA OSHA (federal)
TRAIN STRIKES						
West Haven, CT	05/28	1	0	struck by train	Metro-North Railroad	FRA
Chicago, IL	07/05	1	0	struck by train	Metra	FRA
Socorro, NM	10/17	1	0	struck by train	BNSF Railway	FRA
Walnut Creek, CA	10/19	2	0	struck by train	BART	FTA (California Public Utilities Commission) OSHA (state)
Leasburg, MO	11/05	1	0	struck by train	BNSF Railway	FRA
OTHER ACCIDENTS						
Washington, DC	10/6	1	2	struck by rail held by moving equipment	WMATA	FTA (Tri-State Oversight Committee)
Bradner, OH	10/28	1	1	struck by auto	CSX Transportation	FRA
TOTAL		15	4			

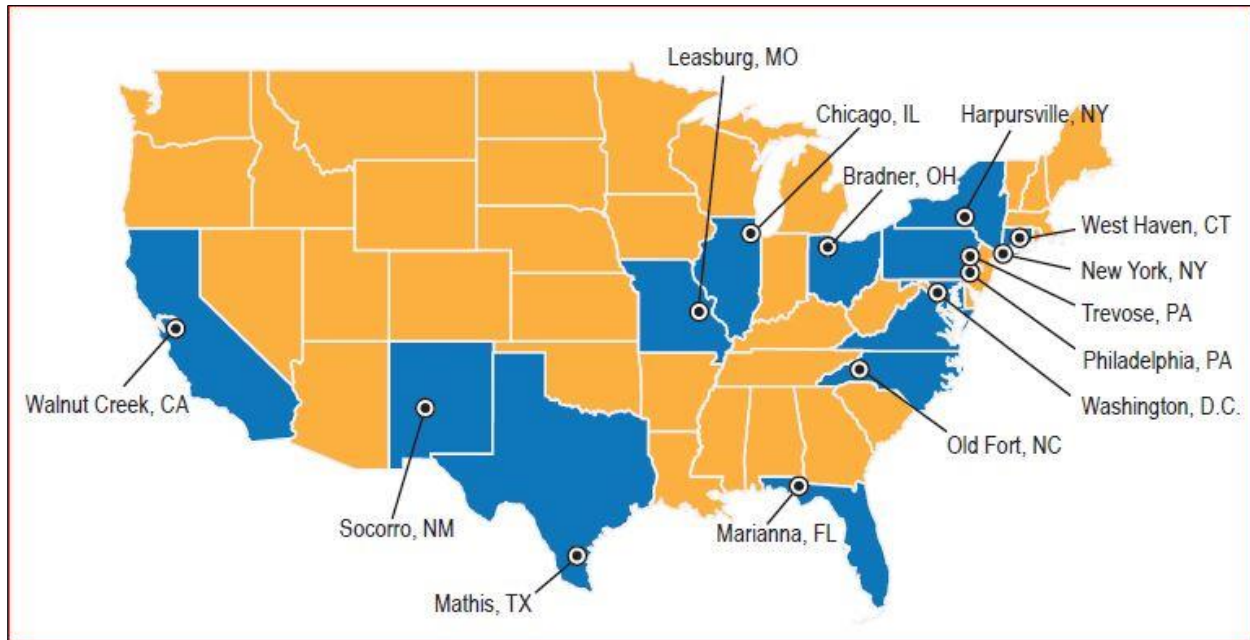


Figure 3. Locations of railroad and rail transit roadway worker fatalities in 2013.

2.1 Natural Hazards

2.1.1 Old Fort, North Carolina

Old Fort, North Carolina, and surrounding local areas experienced heavy rainfall on Sunday, May 5, 2013, one day before the accident.⁶ As a result, Norfolk Southern Railway (NS) track employees had conducted and were continuing to conduct numerous track patrols using hi-rail vehicles (hi-rail) (NS 2012, 21).⁷

On Monday, May 6, 2013, about 2:00 a.m., two NS track employees were in a hi-rail inspecting track. They had conducted a job briefing in the office when they went on duty. Near the entrance of a tunnel at milepost (MP) S120.9, they observed mud on the rail and determined they should not proceed further without clearing the rail. They stopped near the mud, about 40 feet from the mouth of the tunnel. The supervisor told FRA investigators that the mud on the rail appeared to have come from an area just above the mouth of the tunnel. They exited the hi-rail, and one of the employees took a shovel from the bed of the truck and began to clear mud from the rail in front of the hi-rail. The other employee walked toward the back of the hi-rail to get another shovel, and heard what he described as a loud crack. He began to run toward the front of the hi-rail while yelling for the other employee to run. As he passed the front of the hi-rail, he heard a loud thud and felt a gust of air and tree branches fell all around him. He

⁶ Weather data from the Asheville Regional Airport, about 30 miles from the accident site, recorded 3.4 inches of rainfall on May 5, 2013. The NS received a flash flood warning from WeatherBank on May 6, 2013.

⁷ A *hi-rail* vehicle is a maintenance-of-way highway vehicle, often a pickup truck, that is equipped with flanged wheels that can be lowered to allow the vehicle to travel on railroad tracks.

continued to run for about 150 feet, continuing to yell “run” to the other employee. Although he yelled the other employee’s name several times, there was no response. The other employee had been engulfed by a mudslide and died.

The FRA examined the accident site and found that a large tree root ball, along with mud, dirt, and other debris, had slid to the track from the side of the tracks, not from above the mouth of the tunnel. According to emergency responders, 5 to 8 feet of mud was piled up against the front and sides of the hi-rail. The tree root ball had fallen in front of the truck, and the tree trunk had landed on top of the truck. The area just above the slide area had no indications of construction, tree removal, or other ground-disrupting activity that might have contributed to or caused the mudslide. There was no fencing, walls, or other slide protection structures at the side of the track.

The FRA obtained fatigue-related information from the NS, including the 10-day work history for the employee who was overcome by the mudslide. His normal work hours were 7:00 a.m. to 3:30 p.m. On the day of the accident, he had 20.02 hours of continuous wakefulness and had gone on duty at 11:00 p.m. Maintenance-of-way workers are not subject to Hours of Service laws, which prescribe maximum on-duty periods for certain groups of employees.⁸ The FRA determined that the employee likely was fatigued.

The accident occurred in a remote area that was accessible only by walking or hi-rail. At 2:00 a.m. it was dark, the weather was foggy, and a light rain was falling. The temperature was about 50°F.

2.1.2 Trevoze, Pennsylvania

On July 14, 2013, a CSX Transportation (CSX) crew was scheduled to complete several thermite welds near Trevoze, Pennsylvania.⁹ The weather was sunny and humid, and the temperature was 87°F. The crew, consisting of a welder and a welder helper (helper), made the first two welds of the day without any problem. The welder told NTSB investigators it took about 1 1/2 hours to make a single weld. While he was finishing the third weld, he noticed that the weld mold had leaked, requiring additional work. At 12:15 p.m. he notified the employee in charge (EIC) of the delay, stating that the work assignment would not be completed by 2:00 p.m., as planned. At 1:30 p.m. the EIC returned to the work site, and the helper asked for additional water; the employees began the day with 30 bottles of water according to the postaccident statement of the welder. The EIC brought six more bottles of water to the work site and remained with the crew until about 4:00 p.m., when the crew had completed the five welds, including the repairs to the failed weld.

⁸ Title 49 CFR Part 228, Hours of Service of Railroad Employees; Recordkeeping and Reporting; Sleeping Quarters.

⁹ *Thermite welding* is a fusion welding process in which two metals become bonded after being heated by superheated metal that has experienced an aluminothermic reaction. The process involves heating metal to temperatures as high as 4,500°F. The liquid metal that results from the reaction between a metal oxide and aluminum acts as the filler metal. Thermite welding is widely used in field welding of track.

The crew loaded the hi-rail in preparation for leaving the work site. The welder stated that when he moved the hi-rail forward about 10 feet, it derailed on a switch. At 4:24 p.m. the welder radioed the roadmaster and requested equipment to assist in rerailing the hi-rail; the roadmaster sent an end loader to the work site. The welder stated that as he tried to rerail the hi-rail, the helper was sitting in the air-conditioned hi-rail. He said he told the helper that he should get a drink of water or a cup of ice. The welder said the helper responded that he could not because his wife was back there.¹⁰ When an equipment operator arrived with the end loader, the welder returned to the front of the hi-rail.

After rerailing the hi-rail, the equipment operator walked around the hi-rail. He stated that he heard the rustle of brush and walked around the side of the hi-rail, discovering that the helper had fallen down the embankment. He and the welder pulled the helper up the embankment and into the shade. At 4:52 p.m., the 28-year-old helper succumbed to heat stroke. At 5:03 p.m. he was transported to a local hospital, where he was pronounced dead. At the hospital, his core body temperature measured 108°F.

2.1.3 Discussion

The fatalities in Old Fort and Trevoise occurred during and in the vicinity of specific natural hazards. In Old Fort, the work crew was inspecting track following flash flood warnings and attempted to remove mud from the tracks in a remote area at night during foggy weather conditions, where the potential for a mudslide existed. At Trevoise, the work crew that was making thermite welds on an 87°F day did not take precautions to avoid heat-related hazards when their work took more time than expected.

These two accidents are examples of situations in which safety awareness is critical. In both the Old Fort and the Trevoise accidents, the roadway workers should have conducted a job briefing that included hazard identification and mitigation before beginning work. Additionally, both situations—the dangerous mudslide (Old Fort) and the extreme heat along with the defective thermite weld requiring additional work that could lead to heat exhaustion or heat stroke (Trevoise)—required an additional job briefing to address the changing conditions.

During his interview with the FRA, the track supervisor in the Old Fort accident stated that before they exited the truck, the two trackmen discussed where the mud came from and what to do if more mud came down. However, this discussion focused on the mouth of the tunnel, not on the embankment parallel to the track or the fact that there were no fences, walls, or slide detection devices to stop or warn of a mudslide. Nor was there additional discussion when the track supervisor decided to retrieve an additional shovel and participate in the work, leaving no one to function as a lookout. Before beginning a task or when conditions change, an additional job briefing that includes hazard identification and mitigation should occur.

Furthermore, the job briefings conducted at the beginning of the shift in both cases focused on general safety topics, such as the rule of the day, rule of the week, safety statistics

¹⁰ Confusion is a sign of both heat exhaustion and heat stroke. Heat stroke warning signs vary but may also include hallucinations (CDC 2014).

(number of days since last injury), and general work planning, and not on hazard recognition and mitigation associated with the specific tasks that were to be completed during the shift. CSX (Trevose) uses preprinted forms to document hazard recognition and control. However, the entries made on the day of the accident on these forms related to personal protective equipment, and not to specific hazard recognition. Further, the NTSB notes that discussion of general safety topics such as the rule of the day, rule of the week, safety statistics, and general work planning is not a comprehensive job briefing.

In Trevose, because one of the welds had to be redone and the hi-rail had to be rerailed, the day's work took longer than expected. But even with a workday of normal length, the EIC should have thought about the temperature forecast, including the heat index, and should have performed hazard recognition and mitigation.¹¹ For example, neither employee's job briefing record from the day of the accident included discussion of the heat index and mitigation, such as hydrating and resting in a shaded area or the air conditioned hi-rail on a planned schedule. Further, the signs and symptoms of heat exhaustion should have been part of a prejob briefing and included in a job briefing each time the work or task changed (the additional welds required and the derailed hi-rail). The welder at Trevose did suggest to the helper that he drink some water, but despite the helper's odd statement about his wife (a sign of confusion, which should have signaled to the welder that something was wrong with the helper), when the end loader arrived, the welder left the helper and went to rerailed the hi-rail.

In the railroad environment, the need to complete work within specific time "windows" puts additional pressure, both from managers and from employees themselves, on employees to take shortcuts to save time. This may lead to employees' not taking needed water or rest breaks. And in a situation like that at Old Fort, employees may not wait to ensure the work site is safe before beginning work or request additional maintenance or engineering employees to assist with the interpretation of inspection results.

2.2 Falls

2.2.1 Philadelphia, Pennsylvania

On July 15, 2013, two 4-person CSX work crews were replacing bridge timbers on a railroad bridge that supported two main tracks over the Schuylkill River in Philadelphia, Pennsylvania, when the assistant foreman fell through a "hole" in the bridge walkway and was killed.¹² A job briefing had been conducted by the foreman in charge of the project when all members of both crews were present.

The bridge had a walkway constructed of sections of steel grating that became unsecured (loose) when a walkway support joist was cut off to facilitate timber replacement.¹³ The foreman

¹¹ Both employees in the Trevose accident had received heat exhaustion training conducted by CSX.

¹² One crew was assigned to the local area including Philadelphia, and the other crew was a system crew that "floated" systemwide to assist other crews on larger projects.

¹³ Loose grating constitutes a "hole" in the bridge according to a statement made by the FRA Chief Engineer, Structures, during an interview with NTSB investigators. Title 29 CFR 1926.501 requires that employees be

of the local crew (also the foreman in charge of the project) sought help using a chain saw to cut the joist supporting the center of a short section of the walkway. He told NTSB investigators that the assistant foreman from the system crew helped him cut the joist. After the timber joist had been cut, that section of the walkway was unsupported; the foreman stated that he announced that fact to the rest of the crew after the joist had been cut. He said that during the task both he and the assistant foreman were wearing full body harnesses. Each harness had a lanyard that was tied to a rail of the bridge, and each lanyard had a deceleration device.

The foreman stated that after the joist had been cut he untied his lanyard from the rail and carried the chain saw east to put it out of the way. Members of the work crew had differing recollections of where the assistant foreman was after the joist had been cut and when they last saw him on the bridge deck: he was on track 1 between the rails, or he was on track 2 between the rails, or he was moving between the two tracks. No one on the work crew saw the assistant foreman remove his fall protection gear or untie his lanyard. One crewmember, who was sitting in the cab of the hi-rail, which was parked on the track at the end of the bridge, at the time of the accident, recalled seeing the assistant foreman reflected in the side mirror of the hi-rail. He told NTSB investigators he saw the assistant foreman walking on the center walkway toward the hi-rail, and then the assistant foreman fell through a hole in the walkway. (See figure 4.)



Figure 4. Accident location on railroad bridge with loose grating removed.

protected from falling through holes by fall protection systems, hole covers, or guardrails around holes. Title 29 CFR 1926.502 requires that hole covers be marked by color or with the word “HOLE” or “COVER.”

2.2.2 Marianna, Florida

On October 29, 2013, a CSX bridge maintenance crew was modifying and installing walkways and cable handrails on the east side of a railroad bridge over the Chipola River, near Marianna, Florida. On the day before the accident, the crew placed walkway grating on brackets without securing it, creating a “hole” in the bridge. On the day of the accident a job briefing was held with employees at the beginning of the shift; however, there is no mention of the loose grating on any of the job briefing forms, and the fatally injured employee’s form had no entries in the “Hazard Recognition & Control” section.

The assistant foreman was seen walking down the track toward the work site about 3 hours after going on duty. He was wearing fall protection and carrying a coil of steel handrail cable. About 15 minutes later he apparently removed the fall protection, placed it on the bridge deck, and began walking north on the bridge around a hi-rail. After passing the north end of the hi-rail, instead of moving into the gage of the track, he continued walking on the walkway. About 20 feet beyond the hi-rail he fell through the unsecured or loose grating to the ground about 14 1/2 feet below. The loose section of the walkway, weighing about 270 pounds, fell on top of him. He sustained multiple injuries and was taken to the hospital. He died from his injuries in December 2013.

2.2.3 New York City, New York

On the morning of April 24, 2013, a New York City Transit construction work crew was performing preparatory Signal Control Line extension work at the 46th Street Station on the Queens Line. A signal maintainer and a signal helper were assigned as flagmen for the work. The signal employees had gone on duty about 10:00 p.m. on April 23, 2013. They received a toolbox safety talk from their supervisor.¹⁴ The signal maintainer was designated as the primary flagman positioned on track D2 at the north end of the station. The signal helper was assigned as the flagman positioned on the southbound platform to relay information between the primary flagman and the employees who were working south of the station.

At the conclusion of the work, the signalmen were in the process of retrieving flagging lamps, and as they were walking back toward the station (northward), an audible announcement was heard emanating from the platform area that a northbound train was one station away. The signal helper communicated this information to the signal maintainer, who verbally acknowledged the advisory. They continued toward the 46th Street Station, picking up signal lamps on the way. The helper scaled a track ladder, located 23 feet south of the station, and was walking on a walkway called a bench wall when he heard a second audible announcement from the station area that the next train was approaching. He looked back and saw the maintainer place four flashing yellow lamps on the bench wall and then saw him scale the same track ladder to ascend to the bench wall. After entering the station limits, the helper held the gate open for the maintainer. As the train approached the station and illuminated the track area, the helper saw that the maintainer appeared to have lost his balance, and he observed the maintainer wavering before

¹⁴ A *toolbox safety talk or meeting* is a short meeting that focuses primarily on safety topics. It is informal and is used to keep employees alert to work-related accidents and illnesses.

he fell off the bench wall toward the track in front of the train. The maintainer was carrying a signal lamp in front of him and dragging an equipment bag behind him when he fell from the bench wall.¹⁵ About 3:20 a.m., the signal maintainer was struck and killed by the arriving train (New York City Transit 2013).

2.2.4 Discussion

As these three accidents show, falling is a hazard of roadway work, whether the work is performed outdoors on a bridge or in a subway. The fatalities in the two CSX accidents occurred when bridge workers fell through loose grating (hole in a walkway) after removing their fall-protection harnesses, although it is unclear in both cases why the workers removed their harnesses. After a September 19, 2011, bridge worker fatality in Havre de Grace, Maryland, the FRA issued Safety Advisory 2011-03 on November 29, 2011, relating preliminary FRA investigatory findings indicating that the worker had stepped on the unsupported end of an unsecured section of steel walkway grating. The advisory recommended specific railroad actions (*Federal Register* 2011, 75948):

1. Ensure that the grating be kept fastened, unless immediate work requires unfastening. Once the immediate work is complete, ensure that the fastening is reapplied.
2. Ensure that when grating is left unfastened, particularly when sections of grating are shorter than 20 feet, the unfastened grating is identified by marking or signage.
3. Ensure that workers on railroad bridges can safely walk around obstacles, such as on-track equipment.
4. Employ daily safety briefings with all bridge workers of any craft who may be exposed to the hazard of unsecured grating, and specifically identify the location and nature of the unfastened grating. Such daily safety briefings should address what fall protection is being provided and remind bridge workers of the likely specific circumstances when a personal fall arrest system is required or advised.

The Philadelphia accident on July 15, 2013, was almost identical to the Havre de Grace accident—both involved loose grating, obstacles on the bridge, and failure to effectively analyze risk and mitigate hazards. Subsequently, a third fatal accident occurred within a 30-month period, on October 29, 2013, in Marianna, Florida, when a bridge worker was killed when he fell through a hole because of loose grating, obstacles on the bridge, and the failure to use fall protection at the time of the fall. Again, the hazards associated with holes in railroad bridges were not effectively analyzed during the job briefing and the associated hazards were not mitigated.

¹⁵ The bench wall was about 24 inches wide.

The signal maintainer in New York fell from the bench wall in the New York City Transit subway while attempting to reach safety on the station platform before the arrival of a northbound train. He was walking along the narrow bench wall holding equipment in front of him and dragging an equipment bag, which likely contributed to his falling.

Although the New York City Transit signal employees did participate in a toolbox safety briefing conducted by a supervisor, the lack of bona fide safety briefings likely contributed to this accident. A job briefing including hazard recognition and mitigation plans should have taken place once they reached the work site and again each time the work changed. For instance, had they conducted a job briefing before beginning the task of picking up the signal lanterns at the conclusion of the work and identified what action would be taken to ensure they were in a safe location when the next train arrived, the accident may have been avoided. It appears that the audio announcement of the approaching train may have acted as a catalyst for these employees to increase the work tempo so they could catch the arriving train, because train headways during midnight hours are typically prolonged (20-minute intervals). The signal employees should have moved to a safe location and waited for the train to pass upon hearing the announcement of the approaching train.

Similar to accidents discussed previously in this report, the CSX engineering job briefing form had a section titled “Hazard Recognition & Control.” However, a review of these forms showed that the section generally was used to document basic safety topics, for example, slips, trips, and falls; warm ups; and buddy team identities rather than to document hazard recognition and mitigation specific to the job.

Before beginning any roadway work, the roadway worker in charge (RWIC) must consider safety first, then recognize and analyze the multitude of risks and hazards of the job and work environment, and take steps to mitigate the hazards. Second, the foreman must discuss these risks and hazards with all workers in a job briefing. Finally, additional job briefings must be conducted any time the work changes or a new person joins the work crew. The primary safety issue illustrated by these accidents is the importance of basic safety awareness.

2.3 Bucket Lifts

2.3.1 Harpursville, New York

On August 26, 2013, a Canadian Pacific Railway (Canadian Pacific) Bridge and Building (B&B) assistant supervisor was fatally electrocuted while taking measurements of components of a railroad bridge about 60 feet above Highway 235 in Harpursville, New York. He was operating a telescopic boom lift from within the uninsulated bucket when the boom came into contact with an energized overhead power wire and the bucket touched the bridge support. (See figure 5.)



Figure 5. Telescopic boom lift and railroad bridge.

A two-person crew was assigned to provide flag protection for the lift while it occupied one lane of Highway 235. About 6:00 a.m., the crew conducted a job briefing among themselves (no supervisor) at their work headquarters before going to the work site. They were to join a B&B supervisor and a B&B assistant supervisor, who would be taking bridge component measurements, at the bridge.

When they arrived at the bridge, the crew joined the B&B assistant supervisor, who was taking measurements at various locations on the bridge using a ladder. The foreman of the flag crew rode with the B&B assistant supervisor in the lift while the B&B assistant supervisor finished taking measurements with the lift positioned under bridge span 11, away from the highway. The B&B supervisor arrived on scene about the time those measurements were completed. The lift was moved west and down a private road to the highway.

During an interview with NTSB investigators, the B&B supervisor said he gave himself a job briefing on the day of the accident, but during postaccident interviews, the flag crew and the B&B supervisor stated that no job briefing had been conducted with the entire work crew before setting up the lift to work near the energized power lines running beneath the railroad bridge. NTSB investigators reviewed the Canadian Pacific job briefing notebooks for all four workers. The B&B assistant supervisor's job briefing notebook included an entry made on the day of the accident at 6:00 a.m. The task to be performed was listed as "inspections." The section for "New Persons to the work site" was marked "N/A." Three safety rules were noted. Entries were made for "Hazard Recognition." (See table 2.) The remaining three job briefing notebooks had similar entries, but they did not list safety rules.

Table 2. "Hazard Recognition" entries from B&B assistant supervisor's job briefing notebook.

Hazard	Control
Slips & Trips	Watch footing
Ticks	Spray poison
Heights	Lift

Both the OSHA standard Title 29 CFR 1910.333 and Canadian Pacific safety rules require that equipment maintain a minimum 10-foot clearance from energized power lines (greater distances are required with higher voltage lines).

Once the lift was positioned near the highway under the bridge, the B&B assistant supervisor got in the bucket and began operating the lift, extending the boom and lifting the bucket so that he could take measurements under bridge span 9. As the bucket was elevated, the boom came near several wires situated under the bridge. The foreman said he heard the B&B supervisor tell the B&B assistant supervisor (who was operating the boom) that the boom was close to a wire. The B&B assistant supervisor asked the B&B supervisor whether that specific wire could be a tension wire or a guy wire for stabilizing the load between two poles and, if so, the boom's touching it would not be a problem. (See figure 6.)



Figure 6. Extended boom and wire.

The B&B supervisor convinced the B&B assistant supervisor that the boom was close to one of the wires, which was a live wire. They agreed to stop the job and return the bucket to the ground. As the B&B supervisor walked away to get a different perspective to view the operation, the B&B assistant supervisor moved the bucket. As he moved the bucket, the boom touched the live wire, and the B&B assistant supervisor was electrocuted about 11:15 a.m.

2.3.2 Mathis, Texas

On September 4, 2013, about 4:15 p.m., in Mathis, Texas, a Union Pacific Railroad (UP) welder was killed and another welder was seriously injured when an S-65 Trax aerial lift vehicle (aerial lift) overturned.¹⁶

The welder was part of a UP work crew performing maintenance on a wooden railroad bridge. He was using the aerial lift to perform work on bridge connections. The welder was in the aerial lift bucket when it became caught on a bolt that was sticking out of a girder. The welder could not move the bucket despite efforts using the controls inside the bucket. A second

¹⁶ An S-65 Trax aerial lift vehicle is designed to lift personnel and tools to an aerial work site.

UP welder, who had been working on the bridge above the aerial lift, unhooked his fall arrest system and climbed down into the bucket to help release it from the bolt. The welders manipulated the controls from inside the bucket, attempting to release and retract the lift boom. They also tried jumping up and down in the bucket to dislodge the bucket from the bolt. At one point, the bucket suddenly came free from the bolt. The release of tension caused the bucket to drop several feet and accelerate upward unexpectedly, catapulting the second welder out of the bucket and tipping over the Trax vehicle. (See figure 7.) The first welder died, and the second welder suffered serious injuries.



Figure 7. Wreckage of S-65 Trax lift bucket.

On the morning of the accident, the welder went on duty at 9:00 a.m. Investigators from OSHA were told the work crew had received a job briefing from a supervisor. No formal training had been conducted on the use of the aerial lift.¹⁷

2.3.3 Discussion

The bucket lift accidents are examples of roadway work that combines the hazards of working at a height with those of moving equipment and electrocution. Before the Harpursville accident, there was no mention of the required 10-foot distance from a known energized electrical wire hazard. The job briefing form did not include the primary hazard of energized wires and the mitigation to maintain a 10-foot minimum distance from wires, whether or not the

¹⁷ Title 29 CFR Parts 1910 and 1926 require that “Only a trained person shall operate an aerial lift.”

wires were energized. The discussion of whether the wire was a tension wire, a guy wire, or a live electrical wire occurred while the bucket was nearing the wire. In such a situation, it is wiser, and safer, to assume the wire is live.

Also, there was no discussion before the work began of where the bucket should be placed for optimum safety and for satisfactory completion of the work. This should be considered before any work begins, including moving workers and placing equipment at the site of the work. The B&B supervisor and the B&B assistant supervisor discussed the proximity of the bucket to the wires and what type of wires they were. The outcome of their discussion was the decision not to complete the job. However in the final movements of the equipment, the lower portion of the noninsulated boom was in contact with the energized wire, and when the noninsulated bucket likely came in contact with the bridge support it completed the circuit and electrocuted the B&B assistant supervisor. The Harpursville and Mathis accidents clearly show the importance of conducting a job briefing that includes hazard recognition and mitigation before a job begins.

OSHA standards at 29 CFR 1910 and 1926 required a minimum clearance distance of 10 feet from energized 4800-volt power lines and a distance of 20 feet if the voltage was not known. The Canadian Pacific safety rules contained similar specific distance requirements for safety clearance from electrical lines. Canadian Pacific rules also include asking the power company to turn off the power or to place a sleeve on the wire.

The Mathis accident again combined working at a height and using moving equipment. In this case, one of the workers was manipulating the controls of the bucket. It is not clear from the available information whether the bolt on which the bucket became stuck could have been observed before the job began and the welder moved the bucket up toward the bridge. However, even if the bolt was not visible, once the bucket became stuck, the second welder's climbing down into the bucket appears to have been an unplanned, spontaneous attempt to solve the problem. Also, jumping up and down in the bucket may have contributed to the sudden upward movement once the bucket became free of the bolt.¹⁸ The operator's manual and a decal on the lift included the instruction, "Do not attempt to free a caught or snagged platform using platform controls. All personnel must be removed from platform before attempting to free platform using ground controls" (Genie 2011). Also, 29 CFR Parts 1910 and 1926 state that only trained person(s) should operate an aerial lift. The situation in Mathis may not have been possible to foresee, and thus there was no plan to resolve it. However, once the problem at Mathis occurred, the wise response would have been to stop and conduct another job briefing that included hazard recognition and mitigation before taking action to correct the problem.

The accidents in Harpursville and Mathis involved the use of aerial lift equipment by roadway workers. However, 49 CFR Part 214, which governs railroad workplace safety, addresses fall protection only for employees who are performing work on railroad bridges. These regulations do not apply to fall protection when using bucket lifts. The OSHA standards for workplace safety and fall protection, 29 CFR Parts 1910 (General Industry) and

¹⁸ The OSHA standards at 29 CFR Parts 1910 and 1926 require that "employees shall always stand firmly on the floor of the bucket."

1926 (Construction), have primacy for this type of roadway work. The two different regulations for fall protection, applied at the same job site may have led to confusion among the workers about the requirements they were to follow.

2.4 Train Strikes

2.4.1 West Haven, Connecticut

On May 28, 2013, Metro-North Railroad (Metro-North) passenger train 1559, which was traveling westbound at 70 mph on the New Haven Line main track 1, struck and killed a track foreman in West Haven, Connecticut. The accident location was about 100 feet west of catenary bridge 1021 at MP 69.56.

The track foreman reported for work at 8:00 a.m. on the day of the accident. He was briefed by a supervisor; he, in turn, briefed the work crew. The work plan involved relocating segments of rail from main track 1 to industrial track 5 in the vicinity of the new West Haven Station using a locomotive crane. This work was in preparation for the raising and resurfacing of track 1.

At 10:41 a.m., the track foreman contacted the Metro-North rail traffic controller (RTC) to request that main track 1 be removed from service between control point (CP) 266 and CP 271. To fulfill this request, the RTC placed blocking devices to prevent trains from entering the area.¹⁹ At 10:42 a.m., the RTC issued a permit to the foreman that took main track 1 out of service until 4:00 p.m. This action gave the foreman an exclusive track occupancy work area on main track 1. Following Metro-North procedures, the track could not be returned to service until the foreman released it to the RTC.

As the work was performed, the track foreman was occupying main track 1 and the crane was occupying industrial track 5. (See figure 8.) The crane operator began moving sections of rail from main track 1 to industrial track 5 when he heard the horn of a train approaching from the east. The crane operator and the track foreman continued to look to the east and observed the approaching train. The crane operator told NTSB investigators that he could not tell which track the train was on because of a curve in the tracks. He said that he returned his attention to his work because main track 1 was out of service. However, as the train neared, the crane operator realized that the train was on main track 1. He tried to warn the track foreman by yelling for him to run. The operator moved the boom clear of main track just before the train arrived; however, the track foreman did not clear the track. The train struck and killed the foreman, and it struck the rail that was draped over the north rail of main track 1; this collision with the rail knocked the remainder of the rail into the center ditch between main track 1 and industrial track 5.

¹⁹ *Blocking devices* are electronic locks applied in the operations control center that prevent the routing of trains onto tracks.



Figure 8. West Haven accident location showing crane position.

On the day of the accident two RTCs were assigned to the area: a qualified RTC and a student RTC, who was receiving on-the-job training. The student RTC was the RTC who applied the blocking devices for the work crew before the work began and issued the authority to remove main track 1 between CP 266 and CP 271 from service.

At 11:47 a.m., the student RTC removed the blocking devices protecting main track 1 between CP 266 and CP 271 without following the Metro-North procedures, including the track foreman's releasing the authority to the RTC and the RTC's repeating the release of authority to the track foreman before removing the blocking devices. Recorded radio messages and telephone conversations did not reveal any communication between the track foreman and either of the RTCs canceling the authorization. The qualified RTC said that he may have momentarily stepped away from the console, because he had not seen the student RTC remove the blocking devices.

2.4.2 Chicago, Illinois

On July 5, 2013, in Chicago, Illinois, a Northeastern Illinois Regional Commuter Rail Corporation (Metra) tie gang, which is a railroad track maintenance crew, was conducting a

crosstie replacement and surfacing project on the Metra Electric University Park Subdivision. The on-track protection on main track 1 was an out-of-service Form D between MP 3.69 and MP 6.90, which would not permit trains to operate on main track 1 because roadway maintenance machines and workers were occupying that track to conduct their work.²⁰ Their on-track protection on main track 2 was a Form B, which established working limits between MP 4.55 and MP 6.20.²¹ The Form B allowed the RWIC to permit trains to pass through the working limits on main track 2 after ensuring that all roadway workers were clear of main track 2.

The tie gang conducted a job briefing before they were transported to their equipment. The briefing established the place of safety for roadway workers while trains passed on main track 2 to be one of the following:

- Occupying a roadway maintenance machine
- On an adjacent gravel roadway clear of all tracks to the west of main track 1
- Between the rails of main track 1

On the day of the accident, the RWIC allowed 19 commuter trains to operate through the working limits of the Form B on main track 2 between 9:30 a.m. and 1:00 p.m. To operate through the working limits, a train had to request permission from the RWIC. To allow a train to operate through the working limits, the RWIC had to acknowledge the request and direct the assistant foremen, who were positioned between main track 2 and main track 3, to ensure that all workers were clear of main track 2. The assistant foremen then were to blow handheld air horns to notify all roadway workers to go to the designated safe place. Machine operators also were to blow their machine horns after they were notified of an approaching train. After ensuring that all machines had stopped working and the laborers working on the ground were not in the foul of main track 2, the assistant foremen had to notify the RWIC that all workers were “in the clear.” At that point, the RWIC could give the train permission through the working limits on main track 2.

At 1:27 p.m. on July 5, passenger train ME 223 requested permission through the working limits of the Form B on main track 2. The RWIC confirmed with the assistant foremen that all workers in the gang were in the clear, either between the gage of main track 1 or occupying a roadway maintenance machine on main track 1, and gave the train permission to proceed through the working limits at 35 mph past the tie gang on main track 2, the adjacent track. As the train approached, a trackman in the tie gang continued shoveling in the gage of the out-of-service main track 1. About 1:30 p.m., he stepped backward into the foul of the adjacent main track 2 and was struck and killed by train ME 223.

²⁰ Form D and Form B were issued to train crews by the train dispatcher.

²¹ Title 49 CFR Part 214 defines *working limits* as “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.”

The FRA concluded that the fatally injured employee most likely lost situation awareness and stepped into the path of the approaching train (FRA 2013). Metra safety rules and procedures required that employees do the following (Metra 1998):

- Face the direction from which the train is approaching . . .
- Inspect all passing trains . . .
- Stay clear of the track until you are notified that it is safe to return to work.

2.4.3 Socorro, New Mexico

On October 17, 2013, a BNSF Railway (BNSF) trackman was putting his work gear into his personal car, which was parked about 30 feet west and 10 feet north of a BNSF private highway-rail grade crossing just south of the railroad depot in Socorro, New Mexico. The crossing is a passive crossing with no crossbucks or warning signs. The trackman told FRA investigators that he saw a BNSF backhoe parked east of the Socorro depot and main track. He waved at the backhoe and then walked over to it; then the operator got out of the backhoe. The two men talked for about 5 minutes. The trackman then walked back to his car and opened the trunk. Then he heard a train whistle. He told investigators that he could not see the backhoe then because it was behind the Socorro depot, but within moments, the backhoe came into view traveling parallel to the main track. The trackman stated that he gave the backhoe operator a “hot rail” sign (his hand patting the top of his head) but could not tell whether the operator saw the sign; the backhoe then turned onto the crossing, and the operator was struck and killed by the train about 3:19 p.m. Pacific daylight time.

The train was a BNSF southbound train traveling on a single main track on the BNSF El Paso Subdivision of the Southwest Division. The train had 2 locomotives and 77 cars and was traveling at a recorded speed of 46 mph, which is less than the maximum authorized speed of 49 mph for that location. Video from the striking locomotive’s head end camera showed the backhoe moving forward (south) at the east end of and about 8 feet away from the main track. The video also showed the backhoe as it turned into the crossing in front of the train without stopping. The trackman stated that when the train hit the backhoe the impact spun the backhoe around and propelled the operator into the windows of the backhoe, shattering the glass and throwing the operator partially outside the cab.

An excerpt from the BNSF *System Special Instructions* (BNSF 2013) reads as follows:

BNSF MW Rule 12.1.2, Railroad Crossings at Grade

S-12.1.2 *Crossing Tracks*

When crossing tracks with a motor vehicle or off-track equipment at non-public crossing locations:

- Approach as close to a right angle to the track as practical to allow for optimal viewing of potential approaching movements.

- Stop before crossing the track(s), unless the vehicle or off-track equipment is foul of a previously crossed track.
- Look for trains, engines, rail cars and on-track equipment movements approaching from either direction.
- Yield to trains, engines, rail cars and on-track equipment before proceeding across the track(s).

2.4.4 Walnut Creek, California

On Saturday, October 19, 2013, San Francisco Bay Area Rapid Transit District (BART) train 963 was one of only two trains operating on the BART system. Both trains, operated by management employees, were operating for maintenance and training purposes and to transport management employees, and they were not transporting revenue passengers.²²

Train 963, consisting of four passenger cars, was traveling northbound on the BART yellow line between the Walnut Creek and Pleasant Hill stations. Six BART employees were on board the train: an operator trainer/supervisor, two operator trainees, and three equipment maintenance workers. About 1:44 p.m. Pacific daylight time one of the operator trainees (trainee) was operating the train when it struck and killed two roadway workers who were on the railroad tracks: one BART engineering employee and one contractor,. The accident occurred near Walnut Creek, California. No one on board the train was injured.

The BART train control and supervisory system is made up of four major parts: the operations control center, the integrated computer system, an automatic train control system, and on-board automatic train operations computers. An automatic train control system is designed to maintain train separation but does not provide redundant signal protection, such as shunting, for roadway workers. Train operators are also governed by the BART *Operations Rules and Procedures* manual (BART 2008).

NTSB investigators learned that BART had a wayside safety program with general roadway safety practices. One such safety practice was known as “Simple Approval.” Personnel requesting Simple Approval authorization were reminded that they were required to “provide their own protection and not interfere with mainline/yard operations” (BART 2013).

BART rules allowed the control center to grant employees Simple Approval to access the right-of-way and to foul the tracks at the time of the accident. Simple Approval required the employee to be aware of the situation and provide his/her own protection from trains and moving equipment; with this authority the employee was solely responsible for his/her safety. Simple Approval authorization also was a means of keeping the control center aware of the presence of personnel in a specified location in the roadway. To gain a Simple Approval, the employee was required to do the following (in part) (BART 2008):

²² Union-represented employees were on strike at the time of the accident.

- The employee cannot be alone and there must be a watchman/lookout present at the work site.
- The workers must perform a job briefing prior to accessing the right-of-way or fouling the track.
- One of the employees must contact the Train Controller to complete the Simple Approval form with the Train Controller advising of where the work is to be performed, how many employees are involved and when the work is to be completed.
- The employee must have the required means of communication with the control center having jurisdiction for the area involved. And to check that all communication equipment is in good working order.
- For an employee to foul the track for the purpose of working, there must be a watchman/lookout to observe the approach of trains on any track at any time in any direction.
- The watchman/lookout is not permitted to do any work and is to remain vigilant for the approach of trains or equipment.
- The workers must discuss the appropriate speed for the area involved and use a chart to determine the minimum sight distance. If they are not sure of the train speed, they are to assume 80 mph.
- Employees are required to clear the operating envelope of the track at least 15 seconds prior to the arrival of a train or equipment.

On October 18, 2013, the day before the accident, a minor anomaly was noted on the C1 main track. On the day of the accident, two employees planned to take measurements at the anomaly location. One of the employees was a BART track section manager, and the other was a BART contractor. They were working as roadway workers because of the labor strike.

The BART track section manager requested a Simple Approval authorization from the BART train controller at 1:05 p.m. The train controller told NTSB investigators that he provided Simple Approval after he discussed the details of the employee's request via radio. The Simple Approval was requested and granted to allow the two roadway workers to access the right-of-way between C40 (Walnut Creek) and C50 (Pleasant Hill) on the C-1 and C-2 main tracks in accordance with BART rules and regulations.

The trainee told NTSB investigators that as train 963 was exiting a curve (CT-137 15.630 to 15.990) onto a section of straight track about 248 feet long, he thought that he saw something ahead but was not sure if employees were in the track. As the train continued north, the trainee realized there were people on the track and applied the emergency brake (hit the red mushroom button on the control panel). He said he also screamed, "No! No! No!" and was

attempting to press the horn button with his other hand. He said he knew the train was going to hit the employees if they did not get out of the track.

The operator trainer/supervisor said that he heard the trainee's scream and went closer to the operator compartment. The trainee stated he thought the time from when he applied the brake to the impact with the employees in the right-of-way was about 10 seconds. He said that he sounded the horn after placing the train into emergency braking and that the train neared the employees' location and struck the two employees in the track about MP 16.15. This location was in the spiral portion of a curve. The train stopped in the curve several hundred feet past the point of impact. The trainee called the train controller and told him that the train had struck two employees.

2.4.5 Leasburg, Missouri

On November 5, 2013, two BNSF welders set a hi-rail on a single main track outside of their working limits, and the hi-rail was struck by BNSF train H-TULNTW-104. One member of the work crew exited the hi-rail cab before the collision, and the other was killed in the collision.

On the day of the accident, two BNSF roadway workers, a welder and a welder helper, went on duty in Cuba, Missouri. The welder helper was the RWIC, and as such, he secured track and time (on-track protection) electronically via a mobile client called SMART.²³ The RWIC had secured on-track protection on the single main track between the eastbound control signal at Coffeyton, "switch yes," at MP 76.8, and the westbound control signal at Stanton, east siding "switch yes" (ESS), at MP 62.1. "Switch yes" means that the on-track protection includes the switch. Conversely, "switch no" means that the switch is not included in the on-track protection.

The RWIC conducted a job briefing with the welder before departing Cuba, reviewing the on-track protection. They then drove the hi-rail to Stanton, conducted another job briefing, set the hi-rail on the track, and began working. Periodically throughout the morning they were contacted by other roadway workers to coordinate shared use of on-track protection; a track inspector and a section work group contacted the welders at separate times to convey joint track and time.²⁴ The welders stopped and removed the hi-rail from the track for lunch. They did not release their track and time for the lunch break.

After their lunch break, the welders drove the hi-rail on US Interstate 44 westward toward the Coffeyton Road highway-rail grade crossing at MP 77.34, which was outside of their on-track protection limits. The RWIC told FRA investigators that before they set the hi-rail on the track at the Coffeyton Road crossing, he and the welder had discussed whether they had track and time permission to occupy a track for a specific period of time to reach the west siding switch (WSS) Coffeyton at MP 77.3. The welder said they did.²⁵ However, the track and time

²³ The SMART Mobile Client program allows a user to view and save a copy of a track and time permit.

²⁴ *Joint track and time*, when granted by the train dispatcher, allows multiple work crews into the same on-track protection limits.

²⁵ At the time, the SMART program was experiencing a brownout, and the RWIC could not visually verify the on-track protection limits.

issued earlier in the day did not extend to WSS Coffeyton. When the hi-rail arrived at the crossing, the welder pulled the hi-rail onto the track crossing facing east. Then he got out of the hi-rail, put the hi-rail wheels down, and set the truck on the rail. The RWIC told investigators that he stayed in the truck during this time because he was trying to bring the SMART Mobile Client back up after a brownout. The welder then got back in the truck and they proceeded west, in reverse, toward WSS Coffeyton at about 16 mph.

On the day of the accident, eastbound BNSF Train H-TULNTW-104 received an approach indication at WSS Coffeyton and began to reduce speed on the main track at Coffeyton in preparation to stop at ESS Coffeyton. The train crew told investigators that they followed BNSF rules and announced over the radio their location and the absolute signal indication. When the train entered a curve, the engineer saw the hi-rail about 10 car-lengths away with its backup lights on, on the same track, in the middle of the curve. The engineer immediately initiated an emergency application of the train air brakes and sounded the whistle. Just before the train struck the hi-rail, the welder helper jumped out of the vehicle through the passenger-side door. The train struck the hi-rail about 2:29 p.m. at MP 77.85, killing the welder. The train was traveling at a recorded speed of 38 mph. The maximum authorized speed was 50 mph. The welder had set the hi-rail on the track outside of the track and time limits.

2.4.6 Discussion

Less than a month (24 days) before the accident in West Haven, on May 4, 2013, an RTC removed the blocking devices from an occupied track, in error. On May 6, 2013, Metro-North instituted additional operation control procedures, including a software enhancement that requires an RTC to validate the intent to release track authorizations before removing the blocking devices. Despite the additional procedures, this accident occurred on May 28, 2013, killing a Metro-North employee.

It is not clear why the student RTC removed the blocking devices on the day of the West Haven accident, because no cancellation of track authority by the track foreman was recorded. Although a qualified RTC also was assigned to the area, he did not see the student RTC removing the blocking devices. In any event, there was no redundant protection of the roadway worker when the momentarily unsupervised student RTC removed the blocking devices protecting the track on which the track foreman was working.

The NTSB has investigated other accidents involving train movements on tracks occupied by work crews. On January 9, 2007, southbound Massachusetts Bay Transportation Authority (MBTA) passenger train 322 operated by the Massachusetts Bay Commuter Railroad struck a track maintenance vehicle that was on the track near Woburn, Massachusetts (NTSB 2008). The track maintenance vehicle was pushed about 210 feet; the train did not derail. Of the six roadway workers working on or near the track maintenance vehicle, two were killed and two were seriously injured. The NTSB determined that the probable cause of that accident was the following:

the failure of the train dispatcher to maintain blocking that provided signal protection for the track segment occupied by the maintenance-of-way work crew, and the failure of the work crew to apply a shunting device that would have

provided redundant signal protection for their track segment. Contributing to the accident was Massachusetts Bay Commuter Railroad's failure to ensure that maintenance-of-way work crews applied shunting devices as required [by its own rules] (NTSB 2008).

One of the safety issues identified in that investigation included train dispatcher procedures for blocking track segments to protect roadway work crews occupying the track (NTSB 2008).

As a result of the MBTA accident, the NTSB made the following recommendation to the FRA:

R-08-6

Require redundant signal protection, such as shunting, for maintenance-of-way work crews who depend on the train dispatcher to provide signal protection.

Safety Recommendation R-08-6 is currently classified "Open—Acceptable Response."

After the West Haven accident, the NTSB informed Metro-North that it continued to believe that a redundant means of protecting roadway workers from train movements was critically needed and that the protective measures instituted by Metro-North on May 6, 2013, had been inadequate. Therefore, on June 17, 2013, the NTSB reiterated Safety Recommendation R-08-6 to the FRA and also made the following urgent safety recommendation to Metro-North:

R-13-17

Immediately implement redundant signal protection, such as shunting, for maintenance-of-way work crews who depend on the train dispatcher to provide signal protection.

Metro-North developed the Enhanced Employee Protection System (EEPS). EEPS is an automated system that allows employees in the field to control the application and removal of blocking devices by using a random, computer-generated code known to only that employee. In light of this development, Safety Recommendation R-13-17 is currently classified "Closed—Acceptable Action."

In the Metra accident in Chicago, although the RWIC ensured that all roadway workers were clear of main track 2 before he allowed the train through the working limits, he failed to ensure that all the workers had stopped work. When the worker continued to work, even though he was clear of the track, he was not paying attention to or looking at the oncoming train on the adjacent track. As he focused on what he was doing, he stepped back, fouling the track, and was struck by the train. Therefore, the RWIC did not perform his supervisory role effectively, because he did not provide the second layer of safety by telling the worker to stop working and not allowing the train through the working limits until the worker had stopped.

The accident in Socorro occurred at a BNSF private highway-rail grade crossing with no warning signs when a roadway worker drove a backhoe into the path of an approaching train.

The trackman in the same location heard the train whistle, and it is unclear whether the backhoe operator also heard it. However, postaccident inspection of an exemplar backhoe by FRA investigators determined the overall noise level inside the backhoe, without an approaching train, to be minimal.

The backhoe had three mirrors, one each on the outside left and right front corners of the cab and one convex mirror on the inside, slightly off-center to the right, reflecting a larger, closer image. A reenactment, using the factors described in the investigation, with a person riding in the backhoe parallel and about 8 feet from the main track with a train approaching from the rear, showed that the mirrors simultaneously reflected the image of an oncoming train, and the train image grew larger as it approached up to the point of overtaking the backhoe.

Additionally, the backhoe operator was a lone worker. He received a safety briefing conducted by the track supervisor via telephone when he went on duty. The track supervisor stated that the discussion included the rule of the day, the rules of the week, and the general work plan for the day. The backhoe operator had no further supervision on the day of the accident. He did have a radio handset, but the radio was found tuned to the incorrect channel for hearing conversations in the area of the accident.

In the BART accident in Walnut Creek, two roadway workers were fouling the track without a watchman/lookout to observe the approach of trains. A watchman/lookout is an employee whose only duties are to look out for approaching trains or on-track equipment and to provide at least a 15-second advance warning to employees before the arrival of trains or on-track equipment. The on-track protection was in accordance with the BART roadway worker safety practice that allowed the use of Simple Approval when authorizing employees or other roadway workers to enter the right-of-way. BART rules also included the "15-second rule," which requires protection sufficient that workers are able to be clear of an approaching train 15 seconds before a train moving at the maximum operating speed can pass their work locations. Based on postaccident sight distance testing, the NTSB found that the location of the Walnut Creek accident (consecutive curves) and the speed of the train did not allow sufficient time for the roadway workers to get to a safe spot to avoid being struck by the train, and consequently the workers did not recognize the hazard. The sight distance testing also determined that there was insufficient distance for the train to stop before reaching the roadway workers. Had additional watchmen/lookouts with adequate means of communication been on duty in Walnut Creek, or had trains been slowed down when operating in the area where the employees were working or where work in a curve would interfere with the sight distance, the accident may not have occurred.

Since it became effective in 1997, 49 CFR Part 214, Railroad Workplace Safety, has resulted in significant improvement regarding the way freight, intercity, and commuter railroads protect workers on railroad right-of-ways. However, there are no federal regulations similar to Part 214 applicable to rail transit agencies to help ensure that the roadway worker has a safe work environment or to guide rail transit agencies in developing safety programs, rules, and procedures for roadway workers.

Based on the findings of previous investigations and from the BART investigation, the NTSB found there was a significant need for improved roadway worker protection in the rail

transit industry. On December 18, 2013, the NTSB made the following urgent safety recommendations to the FTA to prevent further accidents on BART and other rail transit systems without delay:

R-13-39 (Urgent)

Issue a directive to all transit properties requiring redundant protection for roadway workers, such as positive train control, secondary warning devices, or shunting.

R-13-40 (Urgent)

Issue a directive to require all transit properties to review their wayside worker rules and procedures and revise them as necessary to eliminate any authorization that depends solely on the roadway worker to provide protection from trains and moving equipment.

The FTA issued a Safety Advisory, dated December 2013, that advised all rail transit properties of the urgent safety recommendations issued by the NTSB after the two fatalities at Walnut Creek (FTA 2013). The advisory also included a *Right-of-Way Worker Protection Program Assessment Checklist*, a *Job Safety Briefing Guide*, and a *Sample Field Verification Right-of-Way Worker Protection Compliance Checklist*. Additionally, guidance documents have been issued by the American Public Transportation Association (APTA) and the Transit Cooperative Research Program (TCRP) providing guidance for roadway worker protection programs, rules compliance, and work zone safety:

APTA

Roadway Worker Protection Program Requirements, published November 2011 (APTA 2011).

Rules Compliance, published June 2010 (APTA 2010).

Standard for Work Zone Safety, published July 2004 (APTA 2004).

TCRP

TCRP Synthesis 95: Practices for Wayside Rail Transit Worker Protection, designed to highlight knowledge, practice, lessons learned, and gaps in information related to wayside rail transit worker protection programs (TCRP 2012).

TCRP Report 149: Improving Safety-Related Rules Compliance in the Public Transportation Industry, identifies potential best practices for all of the elements of a comprehensive approach to safety-related rules compliance (TCRP 2011).

However, adherence to the content of these documents is optional, because they are only advisories and guidance documents and not regulations.

The California Occupational Safety and Health Administration (CAL/OSHA) issued three citations to BART at the conclusion of its investigation into this accident, citing the lack of experience of the roadway workers; the insufficient experience of the operator trainee, the lack of direct supervision at the time of the accident, and the “simple approval” policy that allowed wayside access for workers who had to rely on themselves for safety.

In Leasburg, two things went wrong. First, the welder said they had track and time (on-track protection) at the location where they set the hi-rail back on the track after their lunch break, even though the electronic device used for receiving and viewing track and time was unavailable and the location was outside of the track and time limits. Second, although the RWIC and the welder recognized that they had a disagreement on the limits of their track and time, they took no action to resolve the issue safely, and they entered the track outside of the authorized track and time.

BNSF rules and procedures address electronic device failure as follows:

6.2.2 Electronic Display of Authority

B. Loss of Electronic Device Functionality.

Should the electronic device become inoperable and the granted authority text is no longer available, the vehicle must be stopped. Employees must not continue movement until:

- The electronic device returns to normal operation and the granted authority text becomes viewable, or
- Train dispatcher or control operator is contacted and written authority is obtained, recording information on the prescribed form.

Although the welders did have a discussion or job briefing about their track and time before setting the hi-rail back on the track after their lunch break, they did not agree on the limits of the on-track protection. The welder said the authority was to the WSS Coffeyton, but the RWIC could not verify that statement because of the electronic device brownout. The welder continued setting the hi-rail on the track while the helper was attempting to access the SMART mobile client to verify the actual track and time authority.

The incidents from 2013 in which roadway workers were killed when they were struck by trains have in common primarily the lack of attention both to the job and to safety. Further, in four of the five incidents involving train strikes the roadway workers failed to adequately assess and recognize the risks involved and to mitigate or resolve those identifiable risks.

Alternative methods for protecting rail transit roadway workers, such as the control operator’s issuing a notice to the approaching train informing the crew of the location of the roadway workers, or a speed restriction to ensure there was sufficient sight distance for both the train operator and the roadway workers, would likely improve roadway worker safety.

2.5 Other Accidents

2.5.1 Washington, DC

On October 6, 2013, a Washington Metropolitan Area Transit Authority (WMATA) track and structure maintenance production crew (WMATA crew) and a WMATA contractor company were working on a rail renewal project.²⁶ The WMATA crew and contract employees were working between the Judiciary Square and Union Station Metro stations on the Red Line when two WMATA employees were seriously injured and a contract employee was killed by a piece of rail suspended from a crane. The WMATA crew was tasked with removing old rail and replacing it with new rail. The contract employees were responsible for the welding functions. After the ends of the new rail were welded, the WMATA crew ground (or smoothed) the weld. On-track protection was provided through a shutdown work zone with third rail power disconnected, the use of flags, and no trains operating through the work zone between 10:00 p.m. and 4:00 a.m.

The WMATA crew was using a mobile crane operated by an equipment operator, located about 80 feet from the welding location, to lift and remove the rail cut out of the track and to position the new rail sections.²⁷ The contract employees then welded the ends of the new rail together using an on-track flashbutt welding prime mover, located at the other end of the work site, and the WMATA crew ground the weld using a hydraulic profile grinder connected to the flashbutt welding prime mover.²⁸

About 12:03 a.m., a WMATA crewmember reported to the mobile command center that a burst of smoke and fire had originated at the welder head. A worker extinguished the fire with a hand-held fire extinguisher.

Just before the fire, the track supervisor was in the process of removing a rail. After placing the rail tongs on a 39-foot section of 115 lb. rail, the track supervisor had instructed the crane operator to put tension in the cable to secure the rail tongs, a common practice when attaching the rail tongs before lifting the rail.²⁹

²⁶ Rail renewal entails unfastening and cutting old rail, removing the old rail from the rail seat, placing new rail where the old rail was removed, and welding the ends of the new rail together to construct continuously welded rail. After the welding is complete, a profile grinder is used to ensure an even and smooth surface on the rail.

²⁷ A mobile crane is an on- or off-track hoisting machine designed to handle on-track material with a variety of end-of-boom attachments, such as rail tongs, bucket, or magnet, for handling or distributing on-track material in production activities. A mobile crane is often referred to as a speed swing.

²⁸ The flashbutt welding prime mover was manufactured by Plasser American Corporation according to the WMATA procurement specifications, including a fully enclosed cab, a crane, a front-mounted hydraulic tool circuit, a stand-alone diesel powered generator set, a stand-alone compressor, a diagnostic system, and controls for the braking system of WMATA flatcars. Both ends were equipped with an MR type (E) coupler, angle cock, and coupling; A *profile grinder* is used as a first-tier profiling tool to ensure an even and smooth surface is provided for the running rail.

²⁹ The weight of rail signifies the weight of 1 yard of rail, that is, 115 lb. rail means that a 3-foot piece of rail weighs 115 pounds.

Almost immediately after the fire started, the crane moved backward with an old piece of rail seated in the rail fasteners. The backward movement of the crane caused the rail to lift and swing outward from right to left, first striking one WMATA crewmember and a contract employee, who was killed, and then falling on the track supervisor's leg. The crane operator had not been instructed to lift the old rail or move the crane backward.

The Tri-State Oversight Committee (the designated state safety oversight agency) with the responsibility for safety and security oversight of WMATA, used its authority under Part 659 to delegate the responsibility of investigating this accident to WMATA. Both the fire incident and the accident were investigated by the WMATA safety department, that concluded that the fire incident did not contribute to or cause the serious injuries and the fatality.

The WMATA safety department concluded that the fire was a result of atomized hydraulic fluid that was released from a damaged hydraulic hose under pressure that entered a hot work area where welding was being performed.³⁰ The hydraulic hose was damaged when it made contact with a piece of shear slag that was discarded after the last weld was made. The hot metal came in contact with the hose and made a small puncture because of the high temperature of the shear slag. The track repairer (a WMATA crew member) who had performed the previous profile grinding removed the hydraulic hoses from the profile grinder under pressure and returned them to the hose rack.

The WMATA safety department concluded that the cause of the fatality and the serious injuries was not the fire and smoke incident; instead, the cause was the backward movement of the crane by the crane operator without the permission of the track supervisor, who was in charge of directing movement of the crane. The roadway worker protection at the time of the accident was determined to be compliant with WMATA rules and procedures.

The NTSB believes that the fire and smoke incident contributed to the accident by causing the crane operator to move the crane backward inadvertently, which lifted the rail that then struck two roadway workers and fell on another.

Before the accident, the crane operator had worked 12-hour shifts, from 6:00 p.m. until 6:00 a.m., for 5 weeks without a day off. Also, WMATA did not have a formal flashbutt welding procedure at the time of the accident.

2.5.2 Bradner, Ohio

On October 28, 2013, on the Pemberville Subdivision of the CSX in Bradner, Ohio, two CSX employees, an equipment operator (operator 1) and a roadmaster, were standing on Bradner Road, a public highway-rail grade crossing, talking while they waited for a mechanic to repair a spike puller that was on track 1 just east of the crossing. Operator 1 was standing in the road about 20 feet from the highway-rail grade crossing off of railroad property on the north side. He was facing south while he was talking with the roadmaster. The roadmaster told FRA

³⁰ The hydraulic fluid in use had a flash point in the range of 410°F to 460°F. The hot work zone exceeded 460°F in the area of the welder head.

investigators that he saw an automobile stop at a “road closed” sign about 500 feet north of their location and that he then turned to face east and continued his conversation with operator 1. He said that he heard someone yell and he looked around and saw a private vehicle coming toward them.

The private vehicle struck operator 1 and then struck a CSX truck. The CSX truck spun around and hit the roadmaster, knocking him into another equipment operator. All three CSX employees were transported to a local hospital. Operator 1 suffered critical injuries and died on November 29, 2013. The roadmaster suffered serious injuries and was hospitalized, and the other equipment operator was treated and released.

On the day of the accident, a CSX system production gang was replacing continuous welded rail. They reported for duty at 6:30 a.m. at the CSX Bradner siding, where an on-track safety meeting and job briefing were conducted. The gang had exclusive track occupancy on both main tracks. The public road had been closed for construction. The FRA investigation revealed that the road had been correctly closed to upgrade the rail in the highway-rail grade crossing. The local authorities had been notified, and permission was granted to CSX for closure of the road, beginning on October 25, 2013. Signs had been placed to warn motorists of the road closure and to advise traffic that the road was open to local traffic only but closed at the highway-rail grade crossing. These signs were placed on the right side of the road, allowing local access to homes on Bradner Road. Additional signs were placed on the road, blocking all lanes just past the last homes on Bradner Road and before the highway-rail grade crossing. The mechanic had pulled the sign on the north end of the crossing to the west to allow him to drive a truck to the site of the disabled spike puller.³¹

2.5.3 Discussion

In the WMATA accident, the crane operator lifted the old rail and suddenly moved the crane backward without instruction from the track supervisor. WMATA determined that the failure to comply with WMATA rules and procedures led to this accident. However, the crane operator had worked 12-hour shifts from 6:00 p.m. until 6:00 a.m. for 5 weeks without a day off. Therefore, the NTSB believes that fatigue was likely a contributing factor to the accident.

Additionally, as noted previously, the NTSB believes that the fire and smoke incident contributed to the accident by causing the crane operator to move the crane backward inadvertently. The WMATA safety department determined that it did not have a formal flashbutt welding procedure at the time of the accident. The NTSB believes that a formal flashbutt welding procedure outlining a safe welding process, including the storage of hydraulic hoses, would have significantly reduced the fire hazard.

In the Bradner accident, the FRA investigator took no exception to the work site, concluded there were no issues of noncompliance with any of the regulations at 49 CFR Parts 200 to 299, and determined the likely cause of the accident was the negligence of the

³¹ The automobile operator in this accident was charged and convicted on seven counts, including murder and vehicular and felonious assault.

private vehicle operator. However, it is apparent that where railroad work and the public interface, a new set of hazards appears. Nonetheless, the NTSB believes more thorough job briefings would include greater vigilance to mitigate the unpredictable nature of the traveling public.

A roadway worker as defined in 49 CFR Part 214 is any employee of a railroad, or of a contractor to a railroad, whose duties include inspection, construction, maintenance, or repair of railroad tracks, 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 that section. However, Part 214 is silent in regard to any required protection for roadway workers on public and private roads.

3. Safety Issues

The 14 accidents discussed in this report involved several categories of safety hazards, including natural hazards (extreme heat and a landslide), falls (from bridges and bucket lifts), and strikes by moving rail equipment and a private automobile. Moreover, each of the hazard categories included multiple accidents within a single calendar year, indicating that the hazards were not unusual threats to the safety of roadway workers. Rather, the accidents occurred while employees performed their duties in routine fashion. Thus, the NTSB concludes that roadway workers are exposed to diverse hazards in their expected work environments.

To understand the safety issues and develop recommendations, the investigation examined the safety themes evident in the accidents. Our analysis revealed several safety issues, each of which is discussed in the remainder of this section:

- Job briefings
- Regulation and safety oversight
- Fatality Analysis of Maintenance-of-Way Employees and Signalmen (FAMES) Committee
- Safety culture and safety management systems

3.1 Job Briefings

Federal regulations contained in 49 CFR 214.315 require job briefings, and it is likely that the accidents may not have happened had more comprehensive job briefings been conducted beforehand. All except one of the accidents discussed in this special investigation report were preceded by some type of job briefing, safety meeting, or toolbox safety talk.³² The evidence shows that the briefings omitted essential and job-specific elements related to hazard recognition and mitigation. The NTSB believes it is critical that all members of roadway worker groups actively participate in hazard recognition and ensure that hazards are adequately mitigated before work begins. Further, the NTSB believes the previous accident examples and discussion demonstrate that roadway workers are at risk while doing tasks unrelated to the need for on-track protection.

The FRA requires, in 49 CFR 214.315, Supervision and communication, that when an employer assigns duties to a roadway worker that call for the 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. Additional requirements, effective July 1, 2013, require the job briefing to include information about any adjacent tracks, on-track safety for such tracks, identification of any roadway maintenance machines that will foul the tracks, and a discussion of the nature of the

³² NTSB investigators were unable to confirm that a job briefing was conducted before the BART Walnut Creek accident.

work to be performed and the characteristics of the work location. This information is to be communicated again any time the on-track safety procedures change during the work period. A lone worker, at the beginning of each duty period, is to communicate with a supervisor or other designated employee to receive a job briefing and to advise of his or her planned itinerary and the procedures that are intended to be used for on-track safety.

Although on-track protection and procedures are vital elements of a job briefing, a comprehensive job briefing that included an analysis of the task and environmental conditions with appropriate hazard recognition and mitigation would likely have prevented many of these accidents. General discussion of safety and toolbox safety meetings should never suffice for a job briefing. Further, the FRA regulations covering job briefing pertain only to roadway workers' on-track method of protection and do not go far enough to ensure a comprehensive job briefing for all types of roadway work.

3.1.1 Comprehensive Job Briefings

Examples of federal regulations that illustrate a comprehensive job briefing are found at 29 CFR Part 1910, Occupational Health and Safety Standards. Part 1926, Safety and Health Regulations for Construction, also discusses job briefings. Specifically, 29 CFR 1910.269, Electrical power generation, transmission, and distribution, and 29 CFR 1926.952, Job briefing, requires that a job briefing be completed before each job, identifying the existing characteristics and conditions of electric lines and equipment that are related to the safety of the work to be performed before work is started. As listed in Section 1910.269(a)(4), such characteristics and conditions include, but are not limited to, the following:

- The nominal voltages of lines and equipment,
- The maximum switching-transient voltages,
- The presence of hazardous induced voltages,
- The presence of protective grounds and equipment grounding conductors,
- The locations of circuits and equipment, including electric supply lines, communication lines, and fire-protective signaling circuits,
- The condition of protective grounds and equipment grounding conductors,
- The condition of poles, and
- Environmental conditions relating to safety.

Also, subjects required to be covered in the job briefing include hazards associated with the specific tasks performed, work procedures involved, special precautions, energy-source controls, and personal protective equipment. The employee in charge of the work is required to conduct the job briefing and additional job briefings if there are significant changes that might affect the safety of the employees. The rule further requires a more extensive job briefing if the planned

work is complicated or particularly hazardous or if the employee cannot be expected to recognize and avoid the hazards involved in the job. An employee working alone is not required to conduct a job briefing, but the employer must ensure that the tasks to be performed are planned as if a briefing were required.

The Harpursville accident investigation revealed the lack of a joint and thorough job briefing to assess, identify, and mitigate hazards (maintaining a 10-foot minimum clearance to energized electrical lines). However, the FRA on-track job briefing regulation was not applicable to this bucket lift accident. In the BART accident investigation the employees failed to recognize the hazards of track curvature and train speed before beginning work on a section of track that required a lookout. However, no federal regulations applied to this accident because there are none governing roadway worker safety in rail transit. The NTSB concludes that a comprehensive job briefing that could reasonably expect to prevent accidents should include specific criteria as do the OSHA standards at Title 29 Parts 1910 and 1926. The NTSB recommends that the FRA revise the portions of 49 CFR Part 214 for comprehensive job briefings for roadway workers to include the best practices in the OSHA standards contained in 29 CFR Parts 1910 and 1926. Also, the NTSB recommends that the FRA revise its national inspection program to include specific emphasis on roadway worker activities, including emphasizing hazard recognition and mitigation in job briefings.

3.1.2 Rail Transit Roadway Worker Safety

In contrast to the FRA requirements for job briefings, there are no federal regulations requiring job briefings for rail transit roadway workers. As mentioned earlier in this report, APTA and the TCRP have issued documents providing guidance on roadway worker protection programs, rules compliance, and work zone safety, but these documents are subject to voluntary adherence or adoption into rules and procedures of each individual transit property. The NTSB concludes that regulations for rail transit similar to those for railroads establishing roadway worker protection and ensuring job safety briefings that include hazard recognition and mitigation would harmonize rules and procedures and incorporate lessons learned from railroad regulation. Therefore, the NTSB recommends that with assistance from the FRA and OSHA, the FTA establish roadway worker protection rules, including requirements for job briefings. The NTSB further recommends that once the action specified in the previous recommendation is completed, the FTA update the state safety oversight program to ensure that rail transit systems are meeting the safety requirements for roadway workers. The NTSB also recommends that the FRA and OSHA assist the FTA in establishing roadway worker protection rules, including requirements for job briefings.

3.2 Regulation and Safety Oversight

Factors in some of the fatalities discussed in this report include the insufficient oversight by the FRA and, in the case of the rail transit fatalities, the lack of regulation and oversight by the FTA, the regulatory agency overseeing those properties. Other important factors include the responsibilities of the FRA, the FTA, and OSHA and the resulting regulatory gaps and overlaps, and federal authority for investigating fatalities.

3.2.1 Federal Inspections

Federal regulatory oversight is an important component in the prevention of accidents. The FRA conducts inspections, noting areas of deficiency, and may record defects and violations. In response to an NTSB request, the FRA provided the following list of the most frequently noted 49 CFR Part 214, Railroad Workplace Safety, defects from 2004 through 2013:

- Incomplete job briefing
- Improper control of entry to inaccessible track
- Roadway worker fouling a track without ascertaining that provision is made for on-track safety
- Failure to provide initial training
- On-track safety manual not provided to prescribed employees

All of these defects are lapses in the protection of roadway workers and engineering employees who work on or about railroad property. These data indicate that year after year, there continues to be reason for concern about compliance with the regulations that form the basic protection for these workers. For example, Table 3 summarizes FRA inspection activities relating to job briefings from January 1, 2004, through the end of 2013 found in the FRA safety database. A 0315A defect or violation refers to “Failure of employer to provide job briefing,” and a 0315B defect or violation refers to “Incomplete job briefing.” A defect is recorded by the inspector when an exception to the regulations is found that is not especially serious in the view of the inspector. The railroad is expected to correct each defect in a reasonable amount of time. A violation is a more serious exception that results in a civil penalty, to be paid by the railroad or by an individual in the event of a willful violation, and the requirement to immediately fix the problem. Recording a defect or violation is at the discretion of the FRA inspector. All inspectors have completed the same training and continue to train throughout their FRA careers, but there are differences in what each inspector finds and how each inspector handles the exceptions.

In contrast to the established inspection protocol of the FRA, the FTA relies on state safety oversight to ensure rail transit agencies develop and comply with individual system safety program plans. The FTA currently does not have a national inspection program. The NTSB concludes that national inspection protocols for roadway work activities are necessary to ensure the safety of roadway workers on transit properties. The NTSB therefore recommends that the FTA establish a national inspection program that specifically includes roadway worker activities.

3.2.2 Safety Oversight of Rail Transit

The FTA is the federal agency charged with rail transit safety oversight. The FTA’s current approach to rail transit safety encompasses system safety requirements, with each rail transit agency developing rules and procedures, including rules and procedures for roadway worker safety.

The Moving Ahead for Progress in the 21st Century Act of 2012 (MAP-21) is intended to rectify the safety oversight gap under current FTA regulations at 49 CFR Part 659: state safety oversight agencies (SSOA) are limited in their ability to compel a rail transit agency to comply with its system safety program plan or any other FTA requirement.³³ To compound this deficiency, not all rail transit agencies are subject to state oversight.³⁴ Further, those states without state OSHA programs and rail transit properties that do not receive federal transit assistance fall within a safety oversight gap.

Rail transit agencies are not considered railroads and are not regulated by the FRA. Instead, the FTA, as provided in MAP-21, has regulatory authority for the safe operation of rail transit agencies that accept federal funding.³⁵ MAP-21 took effect on October 1, 2012, reauthorizing surface transportation programs through fiscal year 2014. MAP-21 grants the FTA the authority to establish and enforce a new comprehensive framework to oversee the safety of public transportation throughout the United States for heavy rail, light rail, buses, ferries, and streetcars. The requirement in MAP-21 to develop a national public transportation safety plan provides the FTA with a unique opportunity to establish a national vision and framework for more consistent and accountable safety programs applicable to all modes of public transportation within the FTA's jurisdiction. MAP-21 requires, among other things, that the FTA update the state safety oversight program to ensure that rail transit systems are meeting basic, common-sense safety requirements. MAP-21 eliminates the statutory prohibition against imposing broad safety standards for rail transit agencies that receive federal transit assistance that has been in place since 1965. The law stipulates that until new rules are adopted, the provisions of 49 CFR Part 659 will continue.

The FTA has established minimum safety requirements in 49 CFR Part 659, Rail Fixed Guideway Systems, State Safety Oversight, for rail transit that all states must meet to receive federal funding. This regulation includes requirements for periodic review of rail transit agency system safety program plans and compliance with those plans. Part 659 requires that the system safety program plans of rail transit agencies include techniques for conducting inspections, tests, required internal safety and security audits, and inspection programs and procedures for employee training and certification. The regulation also outlines the state safety oversight program and identifies 21 elements that, at a minimum, must be addressed in the rail transit agency system safety program plan.

In 2013, the FTA published an Advance Notice of Proposed Rulemaking seeking public comments on a broad range of topics pertaining to the new public transportation safety program and the requirements of the new transit asset management provisions authorized by MAP-21 (*Federal Register* 2013, 61251). However, the FTA has not promulgated a final rule(s) to update the state safety oversight program.

³³ Some states, such as California and Massachusetts, do not have a safety oversight gap because they have provided their oversight agencies with regulatory and enforcement authority.

³⁴ See [Miami International Airport, Automated People Mover Train Collision with Passenger Terminal Wall, Miami, Florida, November 28, 2008, Railroad Accident Report RAR-11/01, Washington, DC: NTSB.](#)

³⁵ MAP-21 requires the creation and implementation of a national public transportation safety plan to improve the safety of all public transportation systems that receive funding under Title 49 *United States Code* Chapter 53.

The FTA has provided funding for APTA, which issued its consensus-based *Standard for Work Zone Safety* on July 26, 2004 (APTA 2004), and *Roadway Worker Protection Program Requirements* in November 2011 (APTA 2011). However, the FTA is not the sole source for APTA funding.

In comparison to the FRA structure with its practice of inspection and accident investigation, the primary enforcement mechanism available to the FTA is the ability to withhold federal funds from states that do not comply with the terms and conditions of its federal assistance agreement.

In addition, most rail transit employees are not covered by OSHA regulations because, generally, they work for state or local governments or other public sector organizations. The Occupational Safety and Health Act of 1970 (OSH Act) applies to most private sector employers and their workers. The OSHA provisions do not apply to employees of state and local governments. In those states that operate health and safety programs approved by OSHA, rail transit workers would likely be covered by a comparable state law. OSHA has approved state plans covering private sector workers in 25 states, Puerto Rico, and the Virgin Islands. (See the appendix for a table showing OSHA coverage, or lack of OSHA coverage, for each US state and territory. The state plans also cover public sector (state and local government) workers, with state plans in Connecticut, Illinois, New Jersey, New York, and the Virgin Islands covering only the public sector. The OSH Act does include contractors to rail transit agencies, regardless of whether the agency is considered public or private. A regulatory gap exists because rail transit agencies in about half the states are not required to comply with OSHA standards. The NTSB concludes that safety would be enhanced if all rail transit agencies were required to comply with OSHA standards. The NTSB therefore recommends that the FTA revise 49 CFR Part 659 to require all federally funded rail transit properties to comply with 29 CFR Parts 1904, 1910, and 1926.

3.2.3 Occupational Safety and Health Administration Authority

To avoid disputes, OSHA and several federal agencies, including the FRA, have entered into agreements, known as memoranda of agreement (MOA) or understanding (MOU). The MOA between the FRA and OSHA states that the FRA and OSHA have complementary responsibilities in the area of protecting the safety and health of railroad employees. A 1978 policy statement outlined the areas of jurisdiction of the FRA and OSHA in the railroad industry (*Federal Register* 1978, 10583). The FRA exercises authority over railroad operations, and OSHA exercises authority over occupational safety and health issues and provides railroad employees with protection from discharge or discrimination when they have reported safety violations or refused to work in hazardous conditions. The policy statement sought to ensure that the agency with the appropriate expertise evaluate each situation.

In its General Manual, the FRA further stated, as published in the *Federal Register* on March 14, 1978, provisions that effectively preempted OSHA from applying its regulations in areas FRA categorizes, or defines, as “railroad operations” (*Federal Register* 1978, 10583). Such areas include the investigation of certain employee fatalities. OSHA, however, is not precluded from exercising jurisdiction over conditions not rooted in railroad operations or not so closely related to railroad operations as to require regulation by the FRA in the interest of controlling

predominant operational hazards. The FRA also recognized that OSHA investigators have specific expertise in some areas, and conducting concurrent fatality investigations often benefits both agencies. The FRA confers jurisdiction to OSHA in the areas of egress from fixed facilities, general office environments, confined space ventilation, personal protective equipment, and bloodborne pathogens. This special investigation found there are no clear guidelines for roadway workers that might also be affected by OSHA standards. The previous discussions of accidents involving the use of aerial lift equipment by roadway workers highlight how the two different regulations for fall protection, applied at the same job site, may have led to confusion among the workers about the requirements they were to follow. The NTSB concludes that as the bucket lift accidents illustrate, the differences between FRA regulations and OSHA standards may lead to confusion for those planning and executing work. The NTSB therefore recommends that the FRA work with OSHA to establish clear guidelines for use by railroads and railroad workers detailing when and where OSHA standards are to be applied. The NTSB also recommends that OSHA work with the FRA to establish clear guidelines for use by railroads and railroad workers detailing when and where OSHA standards are to be applied.

3.2.4 Investigative Authority

In addition to the NTSB investigations into some railroad and rail transit accidents, the FRA, OSHA, and the FTA through its state safety oversight program are the federal agencies that investigate railroad accidents that result in on-duty railroad employee fatalities.³⁶ However, overlapping authority and gaps in regulatory authority may result in no investigation by a federal agency or confusion as to which federal agency has primacy in an investigation.

The Secretary of Transportation has authority to investigate an accident or incident resulting in serious injury to an individual or to railroad property, occurring on the railroad line of a railroad carrier, that is an accident or incident required to be reported under Title 49 *United States Code* Section 20505.³⁷ The purpose of FRA accident investigations is to promote safety in every area of railroad operations and reduce railroad-related accidents and incidents through regulatory assessments. Thus, the FRA investigates accidents and incidents, with certain limitations, including but not limited to collisions, grade-crossing accidents, and derailments involving either freight or passenger trains.³⁸ The FRA may conduct a parallel investigation or participate as a party to an NTSB investigation. The FRA also investigates on-duty employee and contractor fatalities, regardless of craft. The FRA and OSHA have an MOA to establish accident/incident reporting regulations (OSHA 2012). Accident/incident reporting requirements are established by the FRA in 49 CFR Part 226. Four of the roadway worker fatalities in 2013 occurred in three accidents on rail transit agencies: New York City Transit, BART, and WMATA.

³⁶ MAP-21 grants the FTA authority to investigate rail transit accidents.

³⁷ This implies the general railroad system of transportation and does not apply to installations that are not part of the general railroad system, or systems used exclusively for rapid transit operations in urban areas that are not connected with the general railroad system of transportation.

³⁸ Which accidents and incidents are investigated by the FRA is based on several factors, including the number and severity of persons injured or killed and the scope of the accident determined by the number of cars derailed, the extent of hazardous materials released, and cost thresholds.

Accident/incident reporting and investigation requirements are documented in 49 CFR Part 659 for those rail transit agencies that receive federal funding and are regulated by the FTA. Most rail transit agency employees are considered government (state and local) workers. Therefore, in those states without OSHA-approved state plans, the OSH Act is not applicable. Examples of states that may have rail transit agency employees with no OSHA jurisdiction include Georgia, Florida, and Texas. Although all rail transit agencies that receive federal funds are subject to both 49 CFR Part 659 and state safety oversight, states without an OSHA-approved state plan may not be subject to OSHA standards. The FTA has not entered into an MOA or MOU with OSHA to ensure federal jurisdiction in accident investigations in states without state OSHA plans.

Title 49 CFR Part 659 stipulates that events requiring notification by a rail transit agency are those taking place on a rail transit vehicle or on rail transit-controlled property, and they can involve rail transit passengers, employees, contractors, facility occupants, other workers, trespassers, or other persons. Rail transit agencies are required to notify the SSOA within 2 hours of any incident, including a fatality where an individual is confirmed dead within 30 days or where two or more injuries require immediate medical attention away from the scene.

SSOAs are required to investigate, or require to be investigated, any incident with an employee fatality or injuries as described in the preceding paragraph. The oversight agency must ensure that the investigation is conducted according to procedures reviewed and approved by the SSOA, and those procedures must be submitted to the FTA. In the event the SSOA designates the rail transit agency to conduct the investigation on its behalf, it must do so formally and require the rail transit agency to use investigation procedures that have been formally approved by the oversight agency. The SSOA may also fulfill this requirement by coordinating with an NTSB investigation.

Title 49 CFR Part 659 specifies that a final report, including a description of investigation activities, causal and contributing factors, and a corrective action plan, must be completed. If an entity other than the SSOA is authorized to conduct the investigation, the SSOA must review and approve the final report produced by the investigating entity. The SSOA may adopt the final report, findings, and corrective actions submitted by the rail transit agency, or it may conduct its own investigation.

The NTSB recommends that the FTA establish an agreement with OSHA to collaborate on any investigation of the fatality of an on-duty rail transit employee. The NTSB also recommends that OSHA establish an agreement with the FTA to collaborate on any investigation of the fatality of an on-duty rail transit employee.

3.3 Fatality Analysis of Maintenance-of-Way Employees and Signalmen Committee

An ongoing railroad industry effort to improve safety and reduce fatalities is the FAMES Committee that was created in November 2010 (*Federal Register* 1996, 65959). Members of the

FAMES Committee are representatives from Class I railroads, labor unions, and the FRA.³⁹ The FAMES Committee is a voluntary, consensus-based committee focused on identifying risks, trends, and factors affecting roadway worker safety. The FAMES Committee periodically issues findings and recommendations based upon its review of available safety data. The Committee's activities are focused on education and prevention. The findings and recommendations of the FAMES Committee are separate from the regulatory process.

The FAMES Committee mission statement is the following:

To analyze all fatalities and selected related incidents in order [since the January 1997 implementation of the Roadway Worker Protection Regulations, 49 CFR Section 214, Railroad Workplace Safety, Subpart C, Roadway Worker Protection] to make recommendations to reduce the risk of future occurrences and eliminate fatalities to roadway workers.

The FAMES Committee focuses on roadway worker fatalities by analyzing all available data on these fatalities. These analyses result in reports that include “facts, commonalities, statistics, and recommendations which are intended as educational tools to reduce the risk of future occurrences and eliminate roadway worker protection fatalities” (FAMES 2012). FAMES has issued the following nine reports since its inception:

- Introduction to FAMES
- Fatalities on Adjacent Tracks
- Fatal Accidents Involving RWICs and Lone Workers
- 4th Quarter Safety Alert
- Importance of On-Track Safety Briefings
- Fatal Accident Patterns - Hours of Day
- Fatal Accidents Under Train Approach Warning (Watchman/Lookout)
- Fatal Striking Accidents with Roadway Maintenance Machines Present
- Safety Alert: Use of Electronic Devices

FAMES reports are posted on the FRA website, and the Brotherhood of Maintenance of Way Employes Division (BMWED) posts the reports on its website, publishes them in its quarterly magazine, and sends them to about 2,000 members on its e-mail alerts list.

The types of incidents the FAMES Committee analyzes include fatalities of signalmen and other roadway workers struck by trains or on-track equipment and roadway workers struck

³⁹ FAMES members are APTA, American Short Line and Regional Railroad Association, Association of American Railroads, BNSF, Brotherhood of Maintenance of Way Employes Division (BMWED), Brotherhood of Railroad Signalmen, CSX, FRA, National Railroad Passenger Corporation (Amtrak), NS, Union Pacific Railroad, and Farmrail System, Inc.

by highway motor vehicles at highway-rail grade crossings. Although it is the intent of the FAMES Committee to examine all fatalities, as of the date of this report the committee has not examined all of the railroad accidents or incidents. Related incidents include injuries and fatalities of employees who are not defined as roadway workers by the FRA or the FAMES Committee, such as engineering employees who were performing engineering tasks from bucket lifts or who succumbed to natural hazards. The NTSB concludes that the FAMES Committee has not reviewed fatalities in “related incidents” because those employees did not meet the FRA definition of “roadway worker.” The NTSB recommends that the FAMES Committee include in its publications data on all roadway worker fatalities, regardless of whether the employee is performing roadway worker tasks as defined by the FRA. The NTSB also recommends that the FTA establish a committee for rail transit, similar to the FAMES Committee, that includes participation from interested parties, analyzes all rail transit employee fatalities, and makes recommendations that, when implemented, will prevent future accidents.

3.4 Safety Culture and Safety Management Systems

In each of the accidents discussed in this report, roadway workers failed to identify and respond to potential hazards. Hazard recognition is a vital component of safety management systems (SMS). Three methodologies are used for hazard recognition (ICAO 2012).

- Predictive: identifying hazards before task begins
- Proactive: analysis of existing situations
- Reactive: analysis of past outcomes or events

3.4.1 System Safety Culture and Management

This special investigation identified several themes of safety shortcomings across the accidents discussed, including inadequate job briefings, hazard recognition, and hazard mitigation; limitations and gaps in the current regulatory oversight; and opportunities for improvement for employee empowerment and engagement.

Individual responsibility for safe work behaviors, peer-to-peer support for safe work practices, front-line supervision keenly focused on assurance of work site safety, and company and regulatory standards for safe work practices are elements of an effective safety culture. Safety culture refers to the overarching views and practices of safety within an organization, subscribed to by all individuals throughout the labor and management chain of command, which affect the pervasiveness and efficacy of worker protection programs. Safety culture applies to all aspects of work environment, from initial personnel selection and training, through personal protection devices and work practices, to management and supervisor involvement to ensure the establishment, acceptance, and execution of clear and proven safety policies, procedures, practices, and regulations.

A comprehensive approach to establishing, implementing, and maintaining safe work practices is important, especially given the variability and diversity of jobs and personnel

involved in complex systems, such as railroads and rail transit agencies. Safe work principles must be established, endorsed, and given high priority by senior management. They must also be overseen, facilitated, and reinforced by management closest to the work activities. Those same safe work principles must be understood, respected, and put into practice by all individuals performing the work. Safety culture encompasses the commonly held safety perceptions and beliefs of an organization's members and can influence employee behavior.

The NTSB has long advocated for SMS programs that define safety policies, safety risk management, safety assurance, safety promotion, and safety resource allocation. Hazard recognition is a cornerstone of an SMS. This section discusses a few examples of reactive, proactive, and predictive hazard identification methodologies, but they are also illustrative of recurring areas of opportunity for improvement identified this special investigation. Employee participation is another strong element of SMS. An all-hazards approach to roadway worker protection that expands the federal regulation at 49 CFR Part 214 that currently establishes roadway worker safety to include both on-track hazards and occupational safety, health, and environmental hazards incorporating best practices in job briefings for both railroad and rail transit systems would likely result in improved safety among roadway workers.

3.4.2 Predictive – Hazard Identification and Mitigation

The predictive methodology is the optimum approach for hazard identification. Predictive methodology means to identify any possible hazards before the work task begins. A thorough and complete job briefing, including the analysis of the task to be performed, hazard recognition, and hazard mitigation, exemplifies the predictive methodology.

Hazards are an inevitable part of railroad and rail transit activities. However, they can be mitigated to minimize their consequences or outcomes if they are clearly identified. Comprehensive job briefings that identify the hazards related to the work task, including not only the hazards of train and other on-track equipment strikes, but also those that include natural hazards, falling hazards, bucket lifts, and others as discussed in this report, are vital to maintaining a positive safety culture within an organization thereby preventing accidents.

Further, safety promotion through training and education are vital elements of SMS programs. It is important that roadway workers are competent to carry out their safety roles and responsibilities. This training should include not only rules and procedures, but also methodologies for hazard recognition and hazard mitigation. The NTSB concludes that to recognize dangerous tasks and activities, roadway workers need to know what to look for to identify these workplace hazards. The NTSB therefore recommends that the FRA and the FTA require initial and recurring training for roadway workers in hazard recognition and mitigation. Such training should include recognition and mitigation of the hazards of tasks being performed by coworkers.

3.4.3 Proactive – Peer-to-Peer Safety Responsibility

The proactive methodology is based on the analysis of existing situations. A primary proactive methodology is peer-to-peer safety responsibility, which actively seeks hazard identification in real time. In many of the accidents discussed in this report, had any of the work crew questioned the safety of the assigned task or the work plan and then made the appropriate work adjustments, the fatal injury may not have occurred. The circumstances of these accidents, particularly the ones that occurred in Chicago, Harpursville, Leasburg, Mathis, Old Fort, Walnut Creek, and New York, point to failures in peer support for safety. To safeguard against these failures, workers should be encouraged to share responsibility for safety assurance throughout the work activity and to challenge peers when an unsafe activity is observed. For example, although the two welders in the Leasburg accident discussed the on-track protection, there was neither agreement nor confirmation of the limits of the on-track protection. Had the workers resolved the question either by waiting until the electronic system was restored or by contacting the train dispatcher, the fatal injury may not have occurred.

When employees are assigned tasks that endanger themselves or other employees, or are observed performing tasks in a manner that endangers themselves or other employees, their coworkers should intervene and not let peer pressure or potential negative repercussions, such as criticism from coworkers or management, stop interventions to ensure tasks are completed safely. Workplace hazards that put roadway workers in danger often are not related to on-track safety. The NTSB concludes that every railroad and rail transit work site contains risks beyond those associated with on-track protection and those risks should be managed.

3.4.4 Reactive – Accident Investigation

The reactive methodology is based on a thorough and comprehensive accident investigation that establishes the root cause and contributing causal factors that support the probable cause and safety recommendations to prevent recurrences of the accident. In a safety management environment, once safety defenses such as hazard recognition and mitigation have failed, the accident investigation process has a distinct role in preventing recurrences. Accident investigations may also uncover hazards that may require further followup to appropriately mitigate. Accident investigation data may be used to augment predictive safety data analysis.

As discussed earlier in this report, the responsibility for accident investigations is shared between the FRA, the FTA, OSHA, and the NTSB, as well as the individual railroads and rail transit agencies. Another key perspective can be gained through employee involvement in the investigation process. Employees are the most knowledgeable about the human, technical, and organizational factors that determine the safety of the system as whole. This leads not only to a more thorough investigation, but also to employee buy-in, resulting in a stronger overall safety culture. Although relatively new, the FAMES Committee has been successful in including employee participation in the analysis of railroad accidents.

OSHA, which has regulatory jurisdiction for some elements of workplace safety on railroads and rail transit agencies, provides for union participation in accident investigations. The authority for employee participation is in the OSH Act of 1970 Section 8(e) as implemented by OSHA Directive Number CPL 02-00-150, dated April 22, 2011 (OSHA 2011).

Through its party process, the NTSB has experienced that organizational and employee involvement in accident investigations is instrumental in investigative fact finding. The NTSB has a long history of employee participation through the unions in NTSB accident investigations. When a union employee is involved in an accident, the employee's union is usually offered party status in the NTSB investigation. Title 49 CFR 831.11 contains the rules for designation of parties to NTSB investigations. National unions that represent railroad employees, including the BMWED and the Brotherhood of Railroad Signalmen, have trained accident investigators who serve as party representatives on NTSB investigations.

The NTSB concludes that union representation brings operations-specific knowledge to the accident investigation team and helps facilitate the cooperation of employees. **[Conclusion]** In contrast, investigations of railroad and rail transit accidents conducted by the FRA and the FTA do not have union participation. The NTSB therefore recommends that the FRA and the FTA include union participation in accident investigations similar to that allowed by OSHA. Seek authority from Congress to allow such participation, if necessary.

4. Previous NTSB Safety Action

The NTSB has made recommendations to improve the safety of roadway workers for many years. The accident investigations and the recommendations that resulted from them are discussed in the remainder of this section.

4.1 WMATA – Dupont Circle Station, Washington, DC (May 14, 2006)

About 10:16 a.m. on Sunday, May 14, 2006, a southbound WMATA Metrorail Red Line subway train struck and killed a Metrorail employee as the train was about to enter the Dupont Circle station in Washington, DC. The employee was an automatic train control system mechanic who had been working with two other mechanics at the interlocking just north of the Dupont Circle station. All three mechanics had moved between the two main tracks north of the interlocking in order to stay clear of a northbound train that was leaving the station. As the southbound accident train was arriving, the other two mechanics remained in the clear between the two trains as they passed and were not injured. According to signal system data logs, the southbound train was moving about 40 mph as it traveled past the interlocking.

4.2 WMATA – Eisenhower Avenue Station, Alexandria, Virginia (November 30, 2006)

About 9:30 a.m. on Thursday, November 30, 2006, a northbound WMATA Metrorail Yellow Line subway train struck and killed two Metrorail employees who were performing a routine walking inspection along an outdoor section of main track near the Eisenhower Avenue station in Alexandria, Virginia. The accident occurred as the northbound train was traveling along track normally used for southbound traffic.

The NTSB determined that the probable cause of the Dupont Circle accident was the failure of the automatic train control system (senior) mechanic to stay clear of the approaching southbound train either because he was not aware of the presence of the train or because he lacked a physical reference by which to identify a safe area outside the train's dynamic envelope.

The NTSB determined that the probable cause of the Eisenhower Avenue accident was the failure of the walking track inspectors to maintain an effective lookout for trains and the failure of the train operator to slow or stop the train until she could be certain that the workers ahead were aware of its approach and had moved to a safe area.

The NTSB determined that the following were contributing factors to both the Dupont Circle and the Eisenhower Avenue accidents:

WMATA Metrorail right-of-way rules and procedures that did not provide adequate safeguards to protect the wayside personnel from approaching trains, that did not ensure that train operators were aware of wayside work being performed, and that did not adequately provide for reduced train speeds through work areas. Also contributing to the accident was the

lack of an aggressive program of rule compliance testing and enforcement on the Metrorail system.

As a result of its investigation of these two accidents, the NTSB made the following safety recommendations to WMATA:

R-08-1

Review your *Metrorail Safety Rules and Procedures Handbook* and revise it as necessary to create additional layers of protection for wayside workers, including:

- Adding requirements for wayside pre-work job briefings to ensure that all workers are informed of their duties, of their respective roles in work crew safety, and of the areas that are to be used to stay clear of trains.
- Requiring that when train operators request permission to either enter a main track, or when a train is turned for a return trip, the train operators along the affected lines must acknowledge receipt of the updated radio announcement from the control center regarding wayside workers.
- Establishing procedures to be used for members of a work crew to acknowledge a lookout's warning that a train is approaching on a particular track from a particular direction before a lookout gives an *all clear* signal to a train.

Safety Recommendation R-08-1 is currently classified: "Closed—Acceptable Action."

R-08-2

Establish a systematic program for frequent unannounced checks of employee compliance with Metrorail operating and safety rules and procedures.

Safety Recommendation R-08-2 is currently classified: "Closed—Acceptable Action."

R-08-3

Perform periodic hazard analyses on the deficiencies identified by unannounced checks of employee compliance in response to Safety Recommendation R-08-02, and use the results to revise Metrorail training curricula or enforcement activities, as necessary, to improve employee compliance with operating and safety rules and procedures.

Safety Recommendation R-08-3 is currently classified: "Closed—Acceptable Action."

R-08-4

Promptly implement appropriate technology that will automatically alert wayside workers of approaching trains and will automatically alert train operators when approaching areas with workers on or near the tracks.

Safety Recommendation R-08-4 is currently classified: “Open—Acceptable Response.”

The NTSB issued this safety recommendation in 2008. As discussed earlier in section 2.4.6, after an October 19, 2013, accident in which a BART train struck and killed two roadway workers, the NTSB issued an urgent recommendation to the FTA (R-13-39) to issue a directive requiring redundant protection for roadway workers, such as positive train control, secondary warning devices, or shunting. Therefore, the NTSB reiterates Safety Recommendation R-08-4 and reclassifies it “Open—Unacceptable Response.”

4.3 MBTA – Woburn, Massachusetts (January 9, 2007)

On January 9, 2007, at 1:38 p.m., southbound Massachusetts Bay Transportation Authority passenger train 322 operated by Massachusetts Bay Commuter Railroad struck a track maintenance vehicle that was on the track near Woburn, Massachusetts.⁴⁰ The track maintenance vehicle was thrown forward about 210 feet; the train did not derail. Of the six roadway workers working on or near the track maintenance vehicle, two were killed and two were seriously injured. The NTSB determined that the probable cause of that accident was (1) the failure of the train dispatcher to maintain blocking that provided signal protection for the track segment occupied by the maintenance-of-way work crew, and (2) the failure of the work crew to apply a shunting device that would have provided redundant signal protection for their track segment. Contributing to the accident was Massachusetts Bay Commuter Railroad’s failure to ensure that maintenance-of-way work crews applied shunting devices, as required by its own rules. One of the safety issues identified in that investigation included train dispatcher procedures for blocking track segments to protect maintenance-of-way work crews occupying the track.

As a result of its investigation of this accident, the NTSB made the following safety recommendations to the FRA:

To the Federal Railroad Administration:

R-08-5

Advise railroads of the need to examine their train dispatching systems and procedures to ensure that appropriate safety redundancies are in place for establishing protection and preventing undesired removal of protection for roadway workers receiving track occupancy authority.

⁴⁰ National Transportation Safety Board, *Collision of Massachusetts Bay Transportation Authority Train 322 and Track Maintenance Equipment near Woburn, Massachusetts, January 9, 2007*, RAR-08/01 (Washington, DC: National Transportation Safety Board, 2008).

Safety Recommendation R-08-5 is currently classified: “Open—Acceptable Response.”

R-08-6

Require redundant signal protection, such as shunting, for maintenance-of-way work crews who depend on the train dispatcher to provide signal protection.

Safety Recommendation R-08-6 is currently classified: “Open—Acceptable Response.”

4.4 WMATA – Rockville, MD (January 26, 2010)

On January 26, 2010, about 1:40 a.m., two WMATA automatic train control technicians who were working on the right-of-way were struck and killed by a hi-rail vehicle that was operating southbound about 0.9 miles north of the Rockville Metro Station. Under normal operating conditions, the A-2 track is the northbound track and the A-1 track is the southbound track.

The NTSB determined that the probable cause of the accident was inadequate safeguards by WMATA to protect roadway workers from approaching hi-rail vehicles, and to ensure hi-rail operators were aware of any wayside work being performed. Contributing to the accident was the inadequate communication of vital information concerning ongoing work by the Operations Control Center; the lack of an appropriate and effective lookout by the hi-rail vehicle operator and crew to carefully observe the track on approach; and the ineffective lookout for trains and/or hi-rail vehicles on the part of the automatic train control technicians.

As a result of its investigation of this accident, the NTSB made the following safety recommendations to the FTA and APTA:

To the Federal Transit Administration:

R-12-32

Notify all rail transit agencies regarding the circumstances of the January 26, 2010, accident near Rockville metro station and urge them to evaluate their roadway worker protection programs and procedures to ensure that they adequately and effectively address appropriate training, communication, maintenance-vehicle movement authorities, flagging procedures, rules compliance, and the sharing of a work area by multiple work crews.

Safety Recommendation R-12-32 is currently classified: “Closed—Acceptable Action.”

R-12-33

Advise all state safety oversight agencies of the circumstances of the January 26, 2010, accident near Rockville metro station and urge them to audit the roadway worker protection programs and the procedures of all rail transit operations in their states to ensure that they adequately and effectively address appropriate training, communication, maintenance-vehicle movement authorities, flagging

procedures, rules compliance, and the sharing of a work area by multiple work crews.

Safety Recommendation R-12-33 is currently classified: “Closed—Acceptable Action.”

R-12-34

Issue guidelines to advise transit agencies and state oversight agencies on how to effectively implement, oversee, and audit the requirements of 49 *Code of Federal Regulations* Section 659.19(r) using industry best practices, industry voluntary standards, and appropriate elements from 49 *Code of Federal Regulations* Part 214, Subpart C—*Roadway Worker Protection*.

Safety Recommendation R-12-34 is currently classified: “Open—Acceptable Response.”

R-12-35

Emphasize the effective implementation and oversight of 49 *Code of Federal Regulations* Section 659.19(r) as part of your safety oversight program audits.

Safety Recommendation R-12-35 is currently classified: “Open—Acceptable Action.”

To the American Public Transportation Association:

R-12-36

Establish guidelines and standards to require that all existing and new hi-rail vehicles be equipped with an automatic change-of-direction or backup alarm that provides an audible signal that is at least 3 seconds long and is distinguishable from the surrounding noise.

Safety Recommendation R-12-36 is currently classified: “Open—Acceptable Response.”

4.5 Metro-North Railroad – West Haven, Connecticut (May 28, 2013)

The recommendation below is derived from the ongoing investigation of the Metro-North accident that occurred on May 28, 2013, in West Haven, Connecticut, when Metro-North passenger train 1559 stuck and killed a track foreman. This roadway worker fatality is included in those that occurred in 2013 and included in this report.

The accident occurred at milepost 69.58 main track 1 on the Metro-North New Haven Line. The roadway workers had been granted exclusive on-track protection granted on main track 1. However, the blocking device was removed in the control center by a student rail traffic controller and allowed the train to enter the working limits.

As a result of this accident, the NTSB issued one urgent safety recommendation to Metro-North and reiterated one recommendation to the FRA:

To Metro-North Railroad:

R-13-17 (Urgent)

Immediately implement redundant signal protection, such as shunting, for maintenance-of-way work crews who depend on the train dispatcher to provide signal protection.

Safety Recommendation R-13-17 is currently classified: “Closed—Acceptable Action.”

The NTSB reiterated safety recommendation R-08-6 to the FRA, which was issued after the January 9, 2007, MBTA accident in Woburn, Massachusetts (discussed above).

5. Conclusions

5.1 Findings

1. Roadway workers are exposed to diverse hazards in their expected work environments.
2. A comprehensive job briefing that could reasonably expect to prevent accidents should include specific criteria as do the Occupational Safety and Health Administration standards at Title 29 *Code of Federal Regulations* Parts 1910 and 1926.
3. Regulations for rail transit similar to those for railroads establishing roadway worker protection and ensuring job safety briefings that include hazard recognition and mitigation would harmonize rules and procedures and incorporate lessons learned from railroad regulation.
4. National inspection protocols for roadway work activities are necessary to ensure the safety of roadway workers on transit properties.
5. Safety would be enhanced if all rail transit agencies were required to comply with Occupational Safety and Health Administration standards.
6. As the bucket lift accidents illustrate, the differences between Federal Railroad Administration regulations and Occupational Safety and Health Administration standards may lead to confusion for those planning and executing work.
7. The Fatality Analysis of Maintenance-of-Way Employees and Signalmen Committee has not reviewed fatalities in “related incidents” because those employees did not meet the Federal Railroad Administration definition of “roadway worker.”
8. To recognize dangerous tasks and activities, roadway workers need to know what to look for to identify these workplace hazards.
9. Every railroad and rail transit work site contains risks beyond those associated with on-track protection and those risks should be managed.
10. Union representation brings operations-specific knowledge to the accident investigation team and helps facilitate the cooperation of employees.

6. Safety Recommendations

6.1 New Recommendations

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

To the Federal Railroad Administration:

Revise the portions of Title 49 *Code of Federal Regulations* (CFR) Part 214 for comprehensive job briefings for roadway workers to include the best practices in the Occupational Safety and Health Administration standards contained in Title 29 CFR Parts 1910 and 1926. (R-14-33)

Revise your national inspection program to include specific emphasis on roadway worker activities, including emphasizing hazard recognition and mitigation in job briefings. (R-14-34)

Work with the Occupational Safety and Health Administration (OSHA) to establish clear guidelines for use by railroads and railroad workers detailing when and where OSHA standards are to be applied. (R-14-35)

To the Federal Railroad Administration and the Federal Transit Administration:

Require initial and recurring training for roadway workers in hazard recognition and mitigation. Such training should include recognition and mitigation of the hazards of tasks being performed by coworkers. (R-14-36)

Include union participation in accident investigations similar to that allowed by the Occupational Safety and Health Administration. Seek authority from Congress to allow such participation, if necessary. (R-14-37)

To the Federal Transit Administration:

With assistance from the Federal Railroad Administration and the Occupational Safety and Health Administration, establish roadway worker protection rules, including requirements for job briefings. (R-14-38)

Once the action specified in Safety Recommendation R-14-38 is completed, update the state safety oversight program to ensure that rail transit systems are meeting the safety requirements for roadway workers. (R-14-39)

Establish a national inspection program that specifically includes roadway worker activities. (R-14-40)

Revise Title 49 Code of Federal Regulations (CFR) Part 659 to require all federally funded rail transit properties to comply with 29 CFR Parts 1904, 1910, and 1926. (R-14-41)

Establish an agreement with the Occupational Safety and Health Administration to collaborate on any investigation of the fatality of an on-duty rail transit employee. (R-14-42)

Establish a committee for rail transit, similar to the Fatality Analysis of Maintenance-of-Way Employees and Signalmen Committee, that includes participation from interested parties, analyzes all rail transit employee fatalities, and makes recommendations that, when implemented, will prevent future accidents. (R-14-43)

To the Federal Railroad Administration and the Occupational Safety and Health Administration:

Assist the Federal Transit Administration in establishing roadway worker protection rules, including requirements for job briefings. (R-14-44)

To the Occupational Safety and Health Administration:

Work with the Federal Railroad Administration to establish clear guidelines for use by railroads and railroad workers detailing when and where Occupational Safety and Health Administration standards are to be applied. (R-14-45)

Establish an agreement with the Federal Transit Administration to collaborate on any investigation of the fatality of an on-duty rail transit employee. (R-14-46)

To the Fatality Analysis of Maintenance-of-Way Employees and Signalmen Committee:

Include in your publications data on all roadway worker fatalities, regardless of whether the employee is performing roadway worker tasks as defined by the Federal Railroad Administration. (R-14-47)

6.2 Previously Issued Recommendation Reiterated and Reclassified in This Report

As a result of this investigation, the National Transportation Safety Board reiterates and reclassifies from “Open—Acceptable Response” to “Open—Unacceptable Response” the following safety recommendation:

To the Washington Metropolitan Area Transit Authority:

Promptly implement appropriate technology that will automatically alert wayside workers of approaching trains and will automatically alert train operators when approaching areas with workers on or near the tracks. (R-08-4)

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

CHRISTOPHER A. HART
Acting Chairman

ROBERT L. SUMWALT
Member

MARK R. ROSEKIND
Member

EARL F. WEENER
Member

Adopted: September 24, 2014

Appendix. OSHA Coverage by State/Territory

State/Territory	OSHA Coverage
Alabama	
Alaska	State Plan
Arizona	State Plan
Arkansas	
California	State Plan
Colorado	
Connecticut	Public Employee-Only Plan
District of Columbia	
Delaware	
Florida	
Georgia	
Hawaii	State Plan
Illinois	Public Employee-Only Plan
Indiana	State Plan
Iowa	State Plan
Kansas	
Kentucky	State Plan
Louisiana	
Maine	
Maryland	State Plan
Massachusetts	
Michigan	State Plan
Minnesota	State Plan
Mississippi	
Missouri	
Montana	
Nebraska	
Nevada	State Plan
New Hampshire	
New Jersey	Public Employee-Only Plan
New Mexico	State Plan
New York	Public Employee-Only Plan
North Carolina	State Plan
North Dakota	
Ohio	
Oklahoma	
Oregon	State Plan
Pennsylvania	
Puerto Rico	State Plan
Rhode Island	
South Carolina	State Plan
Tennessee	State Plan
Texas	
Utah	State Plan
Vermont	State Plan
Virgin Islands	Public Employee-Only Plan
Virginia	State Plan
Washington	State Plan
West Virginia	
Wisconsin	
Wyoming	State Plan

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