



***Federal Railroad Administration
Office of Railroad Safety
Accident and Analysis Branch***

***Accident Investigation Report
HQ-2016-1123***

***Amtrak (ATK)
Chester, PA
April 3, 2016***

Note that 49 U.S.C. §20903 provides that no part of an accident or incident report, including this one, made by the Secretary of Transportation/Federal Railroad Administration under 49 U.S.C. §20902 may be used in a civil action for damages resulting from a matter mentioned in the report.

SYNOPSIS

On Sunday, April 3, 2016, at 7:50 a.m., EDT, Amtrak southbound Train Number 89, consisting of one head-end locomotive, eight passenger coaches, one café car, and one baggage car, was operating on Main Track Number 3 at 106 mph when the Engineer noticed maintenance-of-way (MOW) employees and equipment on Main Track Number 3. The Engineer initiated an emergency brake application; however, the train struck a backhoe at 102 mph, resulting in the derailment of the locomotive. The train's impact with the backhoe cast pieces of that machine into the west side of the first passenger coach causing multiple contacts resulting in damage to that passenger coach.

As of August 10, 2016, 85 passengers and 13 Amtrak employees were injured in the collision. Two Amtrak MOW employees, the Backhoe Operator and a Track Supervisor, were fatally injured. Both employees were working under the direction of a Foreman in charge of a ballast replacement project on Main Track Number 2 near Milepost 15.7 on Amtrak's Main Line Philadelphia-Washington segment of the Northeast Corridor. At the time of impact, the Backhoe Operator was in the operating compartment of the backhoe and the Track Supervisor was located on the ground in between Main Track Numbers 2 and 3. The accident occurred near Chester, Pennsylvania, in Delaware County.

According to the manifest, at the time of the accident, there were 334 passengers and 7 Amtrak employees onboard. The Amtrak train crew consisted of an engineer, a conductor, two assistant conductors, and three on-board service attendants.

Amtrak's total estimated damages for the accident are \$3,795,614. Equipment damage to the consist totaled \$3,159,938; track, signal, way, and structure damage totaled \$497,313; and backhoe damage totaled \$138,363.

The weather at the time of the accident was clear, winds from the west at 38 mph and a temperature of 50 degrees Fahrenheit.

The Federal Railroad Administration's (FRA) investigation determined that the cause of the accident was due to an MOW backhoe that was fouling Main Track Number 3 without working limits as required under Title 49 Code of Federal Regulations (CFR) Section 214.319 and referenced by FRA Train Accident Cause Code M404 (Object or equipment on or fouling track).

Contributing Factors are listed below and referenced by FRA Train Accident Cause Code M399 (other causes):

1. Failure of MOW Foreman to apply a Supplemental Shunting Device in accordance with Amtrak Special Instruction 140-S2.
2. Failure of MOW Foreman to apply whistle board signs at the work location in accordance with Amtrak Roadway Worker Protection Manual Rule 339(1).
3. Failure of MOW Foreman to use radio when canceling foul time in accordance with 49 CFR § 220.61(a).
4. Failure of MOW Watchman to raise orange disc on approach of train in accordance with Amtrak Roadway Worker Protection Manual Rule 329(a)(4).
5. Failure of MOW Foremen to provide a job briefing for on-track safety in accordance with 49 CFR § 214.315(b).



FRA FACTUAL RAILROAD ACCIDENT REPORT

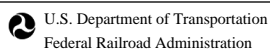
FRA File #HQ-2016-1123

TRAIN SUMMARY

1. Name of Railroad Operating Train #1 Amtrak (National Railroad Passenger Corporation)	1a. Alphabetic Code ATK	1b. Railroad Accident/Incident No. HQ-2016-1123
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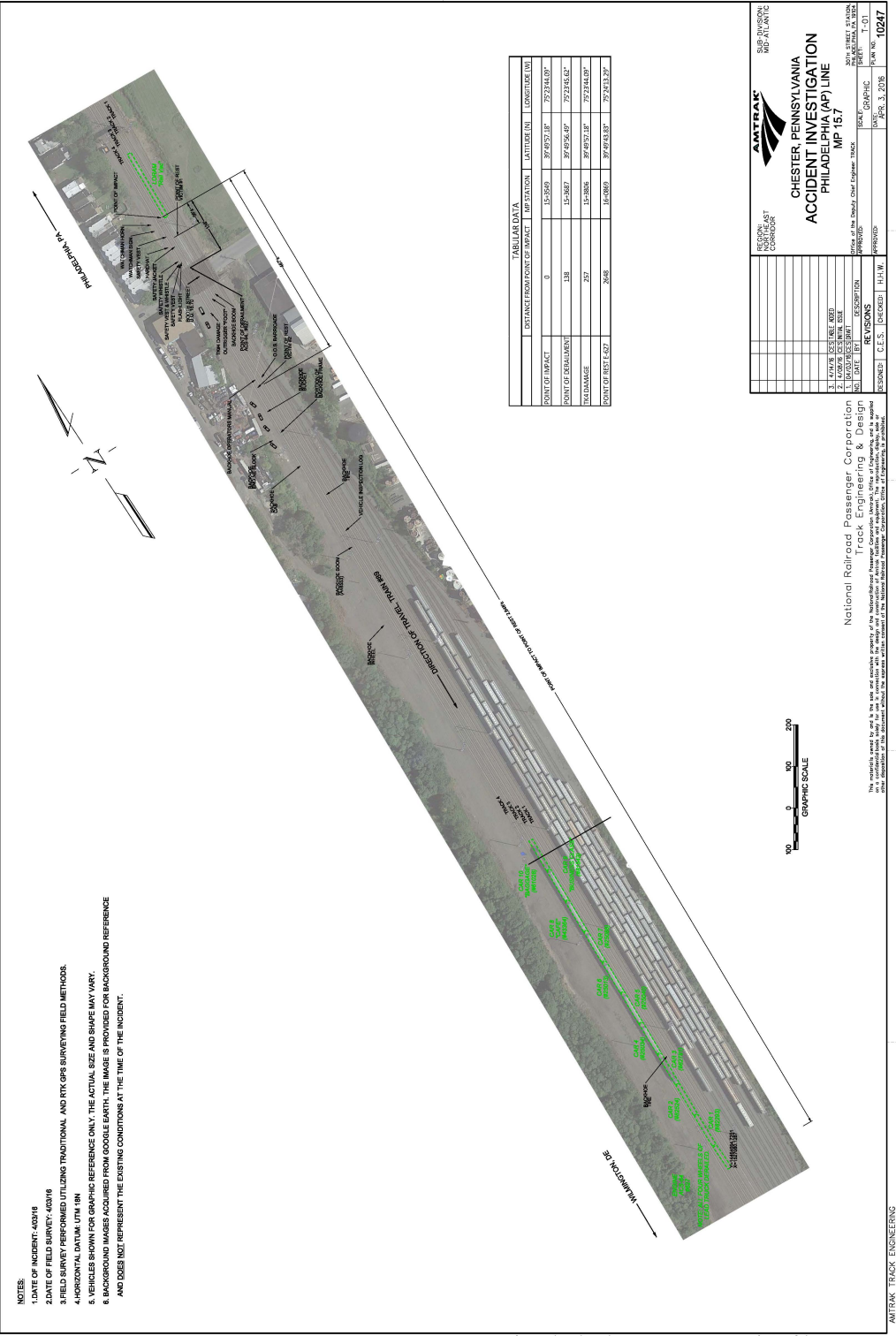
GENERAL INFORMATION

1. Name of Railroad or Other Entity Responsible for Track Maintenance Amtrak (National Railroad Passenger Corporation)		1a. Alphabetic Code ATK		1b. Railroad Accident/Incident No. HQ-2016-1123	
2. U.S. DOT Grade Crossing Identification Number		3. Date of Accident/Incident 4/3/2016		4. Time of Accident/Incident 7:50 AM	
5. Type of Accident/Incident Obstruction					
6. Cars Carrying HAZMAT 0	7. HAZMAT Cars Damaged/Derailed 0	8. Cars Releasing HAZMAT 0	9. People Evacuated 0	10. Subdivision Main Line - Philadelphia to Wash	
11. Nearest City/Town Chester, PA		12. Milepost (to nearest tenth) PW15.7	13. State Abbr. PA	14. County DELAWARE	
15. Temperature (F) 50 °F	16. Visibility Day	17. Weather Clear		18. Type of Track Main	
19. Track Name/Number Main Track No. 3		20. FRA Track Class Freight Trains-110, Passenger Trains-110		21. Annual Track Density (gross tons in millions) 9	22. Time Table Direction South

		FRA FACTUAL RAILROAD ACCIDENT REPORT				FRA File #HQ-2016-1123							
OPERATING TRAIN #1													
1. Type of Equipment Consist: Passenger Train-Pulling					2. Was Equipment Attended? Yes		3. Train Number/Symbol 89						
4. Speed (recorded speed, if available) R - Recorded 102 MPH E - Estimated		Code R	5. Trailing Tons (gross excluding power units)		6a. Remotely Controlled Locomotive? 0 = Not a remotely controlled operation 1 = Remote control portable transmitter 2 = Remote control tower operation 3 = Remote control portable transmitter - more than one remote control transmitter			Code 0					
6. Type of Territory Signalization: <u>Signaled</u> Method of Operation/Authority for Movement: <u>Signal Indication</u> Supplemental/Adjunct Codes: <u>J, A</u>													
7. Principal Car/Unit		a. Initial and Number	b. Position in Train	c. Loaded (yes/no)	8. If railroad employee(s) tested for drug/alcohol use, enter the number that were positive in the appropriate box		Alcohol	Drugs					
(1) First Involved <i>(derailed, struck, etc.)</i>		AMT 627	1	yes			0	3					
(2) Causing <i>(if mechanical, cause reported)</i>		NA	0	no	9. Was this consist transporting passengers?			Yes					
10. Locomotive Units (Exclude EMU, DMU, and Cab Car Locomotives.)		a. Head End	Mid Train		Rear End		11. Cars (Include EMU, DMU, and Cab Car Locomotives.)		Loaded		Empty		e. Caboose
			b. Manual	c. Remote	d. Manual	e. Remote			a. Freight	b. Pass.	c. Freight	d. Pass.	
(1) Total in Train		1	0	0	0	0	(1) Total in Equipment Consist		0	10	0	0	0
(2) Total Derailed		1	0	0	0	0	(2) Total Derailed		0	0	0	0	0
12. Equipment Damage This Consist 3159938			13. Track, Signal, Way & Structure Damage 497313										
14. Primary Cause Code M404 - Object or equipment on or fouling track - other than above (for vandalism, see code M503)													
15. Contributing Cause Code M399 - Other causes (Provide detailed description in narrative)													
Number of Crew Members							Length of Time on Duty						
16. Engineers/Operators		17. Firemen		18. Conductors		19. Brakemen		20. Engineer/Operator			21. Conductor		
1		0		1		2		Hrs: 1 Mins: 55			Hrs: 1 Mins: 55		
Casualties to:		22. Railroad Employees		23. Train Passengers		24. Others		25. EOT Device?			26. Was EOT Device Properly Armed?		
Fatal		2		0		0		N/A			N/A		
Nonfatal		13		85		0		27. Caboose Occupied by Crew?			No		
28. Latitude 39.832325000				29. Longitude -75.396090000									

SKETCHES

ATK89 - Survey Map



NARRATIVE

Circumstances Prior to the Accident

Amtrak operates track geometry test vehicles over the Northeast Corridor (NEC) to determine locations of developing geometry deficiencies in order to schedule maintenance crews to address locations identified through the testing programs. A location on Amtrak's Main Line-Philadelphia to Washington (PW) located at Milepost (MP) 15.7 on Main Track Number 2, was scheduled for ballast replacement and surfacing to provide a long-term solution to an area of fouled ballast and geometry concerns that were causing a rough ride for passengers and vertical stress to the track structure. Amtrak Engineering personnel developed a program to eliminate a series of fouled ballast locations using a Loram Vacuum Unit, maintenance crews and a backhoe to facilitate loosening cemented mud locations. Part of the program development included a scheduled 55-hour track outage for the MP 15.7 location. This work began on April 1, 2016, at 10:00 p.m., EDT, through April 4, 2016, at 5:00 a.m.

On April 2, 2016, at 7:10 p.m., the Amtrak Night Foreman conducted an on-track safety briefing on the right-of-way near MP 15.7 in Chester, Pennsylvania, with six employees and contractors. The Night Foreman used an Amtrak-issued "on track safety briefing sheet" to address all safety concerns. Upon completion of the briefing, all employees and contractors signed the on-track safety-briefing sheet to acknowledge that they understood the on-track safety procedures and instructions presented. After the briefing, the Night Foreman called the Dispatcher to obtain exclusive track occupancy on Main Track Number 2 by means of a "Form-D." Amtrak issued Form D A1403 to the Night Foreman on Main Track Number 2 between Hook and Baldwin Interlockings. The Night Foreman acquired foul time on Main Tracks Numbers 1, 3, and 4 throughout his shift using a company-issued radio as needed. Foul Time was required on adjacent tracks when the Loram Vacuum Unit was working or the backhoe was fouling track. According to Amtrak Special Instruction 140-S2, if the backhoe or any other equipment would be required to foul a track in signal territory or within an interlocking for more than 5 minutes, application of a supplemental shunting device (SSD) would also be required. However, Amtrak failed to apply SSDs during the 55-hour outage.

During an interview with Amtrak, FRA, and the National Transportation Safety Board (NTSB), the Assistant Track Supervisor said he arrived at the job site at 8:40 p.m. and the Backhoe Operator arrived at the job site at 11:00 p.m. Both employees received a job briefing from the Night Foreman and signed the on-track safety briefing sheet. During an interview with Amtrak, FRA, and the NTSB, the Night Foreman said that after the Backhoe Operator received his on-track safety briefing, high winds and rain prevented the night gang from working. At approximately 12:52 a.m., April 3, 2016, Amtrak issued the Night Foreman foul time on Track Numbers 1, 3, and 4 and the night gang returned to work. At approximately 6:30 a.m., the Track Supervisor arrived at the work location and relieved the Assistant Track Supervisor. Thirty minutes later, at 7:00 a.m., the Day Watchman and Trackman arrived at the work site. The two received a job briefing from the Night Foreman and relieved the Night Watchman and Night Trackman. The Trackman worked with the Track Supervisor on Main Track Number 2. The Day Watchman stood on the field side of Main Track Number 4 and assumed Watchman duties. Watchman duties require a designated roadway worker to devote their full attention to detecting the approach of

trains and provide audible warning and raising an orange disc or approved light at arm's length above the head to warn roadway workers of approaching trains.

On April 3, 2016, at 7:27 a.m., the Night Foreman called the Dispatcher with his personal cell phone and requested to cancel Form D A1403 and give back foul time on Main Track Numbers 1, 3, and 4 while the backhoe (A-48553) was still fouling on Main Track Number 3. Before canceling his foul time, the Night Foreman informed the Dispatcher that the Day Foreman was going to "pick them up" (the Day Foreman would acquire foul time through the Dispatcher). The time effective for the cancellation of Form D A1403 was 7:28 a.m. The time effective for the Night Foreman clearing his foul time on Main Track Numbers 1, 3, and 4 was 7:29 a.m. Prior to the cancellation of Form D A1403 and the subsequent release of foul time, the Day Foreman called the Dispatcher at 7:16 a.m. for a briefing and was instructed by the Dispatcher to call back in a few minutes for a Form D. At 7:24 a.m., the Day Foreman called back on his company cell phone and Amtrak issued Form D A1401 for Main Track Number 2 between the Hook and Baldwin Interlockings, with a time effective at 7:26 a.m. When the Dispatcher asked about foul time he said, "I need to check first." The next time the Day Foreman spoke to the Dispatcher was after Train Number 89 collided with the backhoe and asked if the Night Foreman still had foul time. The Dispatcher replied, "no."

Train Amtrak 89 South

The southbound crew of Amtrak Train Number 89 included a locomotive engineer, a conductor, two assistant conductors, and three on-board service attendants. Employee training records indicated that the train crew employees were qualified to Federal standards with their medical and training records being up to date including passing scores on rule and test exams. Amtrak certified all applicable crewmembers on the equipment used and the physical characteristics of the territory. They first went on duty at 5:25 a.m., April 3, 2016, at Amtrak's Penn Station in New York, New York. This was the home terminal for all crewmembers, and all received more than the statutory off-duty period prior to reporting for duty.

Amtrak 89's consist was one electric locomotive, eight coach cars, one café car, and one baggage car. The Federal Railroad Administration (FRA) determined that all the systems and sub-systems were working as intended and the equipment involved in the derailment of Amtrak 89 was not a factor, or contributing factor to the cause of the accident. Amtrak 89 was 912 feet long and weighed 1,172,000 pounds or 586 tons. Amtrak 89's final destination was Savannah, Georgia.

The train crew took possession of Amtrak 89 at Penn Station, New York, and performed the required air brake test, mechanical, and safety equipment inspections. With all passengers boarded, Amtrak 89 departed Penn Station at 6:05 a.m. Prior to arrival at Philadelphia, Pennsylvania, Amtrak 89 made four scheduled station stops at New York; Newark, New Jersey; Metropark, New Jersey; and Trenton, New Jersey, with no reported problems. Amtrak 89 departed 30th Street Train Station in Philadelphia at 7:32 a.m. and traveled south on Main Track Number 3. Train Number 89 proceeded through Baldwin Interlocking (MP 11.5) at 106 mph.

The Locomotive Engineer sat at the controls of Locomotive Number 627 as the train approached the accident area. The First Assistant Conductor was in the first car behind the locomotive, the Second Assistant Conductor was in the ninth car, and the Conductor was located in the fourth car. The on-board service attendants were located in the café car. The accident site is a four-track main equipped with

wayside block signals, on-board cab signals, and Advanced Civil Speed Enforcement System (ACSESII) as prescribed by Amtrak's Timetable Special Instructions. The timetable speed for Main Track Number 2 and Number 3 was 110 mph between Baldwin and Hook Interlocking. The timetable speed for Main Track Number 1 and Number 4 was 90 mph between Baldwin and Hook Interlocking. The railroad timetable direction of the train was south.

The weather conditions were clear, winds from the west at 38 mph and a temperature of 50 degrees F. FRA found all wayside and cab signal aspects in compliance with the regulations under Title 49 Code of Federal Regulations (CFR) Part 236.

Maintenance-of-Way (MOW) Employees and Contractors

Just prior to Amtrak 89 striking the MOW backhoe, the MOW gang was working on the north-end of the Booth Street under-grade bridge at MP 15.7 on Main Track Number 2. The head-end of the Loram Vacuum Unit (LORA048553) was facing south approximately 138 feet north of the bridge and working in the north direction. There were three Loram contractors working with this Loram Vacuum Unit. Two Loram contractors were inside the cab with the Day Foreman (Roadway Worker in Charge) and one Loram contractor was on the ground near the front of the Loram Vacuum Unit. Amtrak's Track Supervisor was facing south and standing in front of the Loram Vacuum Unit, between Main Track Numbers 2 and 3 on the field side of Main Track Number 2. The Trackman was standing next to the Track Supervisor in the gage of Main Track Number 2, facing west. The backhoe was facing south on Main Track Number 3 with the Backhoe Operator sitting at the controls also facing south. He was not actively working. The Day Watchman was in front of the Loram Vacuum Unit on the right-of-way next to Main Track Number 4.

The Accident

Train Amtrak 89 South

At 7:49:15 a.m., Amtrak 89 approached the accident area, traveling 106 mph. Shadows cast from the Loram Vacuum Unit obstructed the Engineer's view of the work site on Main Track Numbers 3 and 4. At 7:49:41 a.m., the Engineer became aware of the impending collision about 450 feet in advance, at which time he initiated an emergency train air brake application. The train had slowed to 102 mph when the collision occurred around 7:49:44 a.m. Approximately 138 feet past the point of impact (POI), Amtrak Locomotive 627 derailed its front truck (F-end) due to backhoe debris. Amtrak 89 continued south with the lead truck (F-end) of the locomotive derailed for 2,510 feet before coming to a stop. The controlling engine's event recorder digitally captured the above speeds. The maximum authorized speed for this train was 110 mph, as designated in the current Amtrak Timetable No. 6 Special Instructions.

Backhoe Loader - Amtrak Equipment Number A-48553

The backhoe was stationary on Main Track Number 3. After reviewing the outward-facing camera on Amtrak Number 89's locomotive, it was determined that the backhoe loader was facing in the south direction with front bucket facing south and resting on the west rail. Both outriggers were down and the rear window was in the open position. The rear boom was also down with the cribbing bucket resting on the ballast between two concrete ties, inside the gage of the track. The rear work lights were on. The Backhoe Operator was sitting in the operator's seat and facing south. The outward-facing camera cut off at the POI due to damage from the backhoe.

The train struck the rear of the backhoe (at the rear boom). Upon collision, the backhoe virtually

exploded, separating all of the main components of the machine and throwing them in different directions and distances. The Backhoe Operator sustained fatal injuries directly from the collision. The Track Supervisor sustained fatal injuries by the flying debris from the backhoe. The Trackman suffered a broken arm by the flying debris from the backhoe. The train came to a stop about 2,648 feet south of the POI.

After the train stopped, the Engineer stayed on the locomotive and attempted to establish radio communications with the Dispatcher, however, the radio equipment was inoperable. He remained on the locomotive until first responders arrived.

The Conductor and Assistant Conductors remained in the coach cars and assisted the passengers. Less than 2 minutes after the accident, at 7:51:25 a.m., the Day Foreman called the Dispatcher. First, the Day Foreman asked the Dispatcher if the Night Foreman still had foul time. The Dispatcher informed him that the Night Foreman gave up his foul time. Next, the Day Foreman informed the Dispatcher that a train struck the MOW gang's backhoe, MOW employees were injured and they required medical assistance.

Seven seconds later, an off-duty Amtrak Train Dispatcher called the Assistant Chief Train Dispatcher to inform him that he was on board Amtrak 89 and the train was involved in an accident, there was damage to the train and people on board the train were injured. The Assistant Chief Train Dispatcher told the off-duty Train Dispatcher that he was calling Amtrak Police Department (APD) to respond.

Amtrak Assistant Chief Dispatcher called APD Dispatcher, (Operator 2005) at 7:54:47 a.m., to inform him that Amtrak 89 struck a MOW backhoe and there were multiple injuries. APD confirmed the location and dispatched officers to the scene.

Chester Fire Department (Station 82) arrived on scene at 8:00 a.m., to provide first aid and transport to the passengers of Amtrak 89. Chester Fire Department provided transportation to their designated shelter location at Trainer Methodist Church on West Ninth Street and Langley Street in Marcus Hook, Pennsylvania.

APD arrived on the scene at 8:06:00 a.m. APD assisted the Chester Fire Department in evacuating injured and non-injured passengers to the designated shelter location. Once the scene was clear of passengers, APD began to set up security for the accident scene.

Transportation for the uninjured passengers of Amtrak 89 from the shelter at Trainer Methodist Church to Philadelphia 30th Street Station by Southeastern Pennsylvania Transportation Authority buses took place at 11:00 a.m.

As of August 10, 2016, 85 passengers and 13 Amtrak employees were injured in the collision. Two Amtrak MOW employees (the Backhoe Operator and a Track Supervisor) were fatally injured. The total estimated damage for the accident was: \$3,159,938 in equipment damages to the consist; \$497,313 in damages to the track, signal, way and structure; and \$138,363 in backhoe damages.

Post-Accident Investigation

Analysis and Conclusions

Analysis - Fatigue: FRA obtained fatigue-related information, including a 10-day work history of all employees involved in the Amtrak 89 accident. FRA uses an overall effectiveness rate of 77.5 percent as the baseline for fatigue analysis. At or above this baseline, FRA does not consider fatigue as probable for any employee. Software sleep settings vary according to information obtained from each employee.

If an employee does not provide sleep information, FRA uses the default software settings.

Conclusions – Fatigue: At the time of the accident, several employees were suffering from varying degrees of fatigue. However, FRA concluded that fatigue was not a primary or contributing cause of the accident.

Analysis – Toxicology: This accident met the criteria for 49 CFR Part 219, Subpart C, Post-Accident Toxicological Testing. In accordance with Federal regulations, following the accident, operating crewmembers from Amtrak 89 and the two deceased MOW employees were required to undergo post-accident toxicological testing.

FRA's Post-Accident Forensic Toxicology Result Reports indicate the surviving Engineer was positive for marijuana in both his urine and blood. FRA's laboratory also verified the presence of morphine in the Engineer's urine. Morphine was medically administered after the accident to treat his injuries. The deceased Track Supervisor was positive for two opioid narcotics in his blood: morphine and oxycodone. The deceased Backhoe Operator was positive for cocaine use in both his vitreous and urine. The concentration levels suggest very recent use of the drug, but due to the lack of sufficient vitreous, no more-specific estimate can be made.

Conclusions - Toxicology: Toxicology testing determined a positive result for three employees that were required to submit a screening under 49 CFR Part 219, Subpart C. The Engineer and Backhoe Operator screenings suggest very recent or habitual use of narcotics. Although these three employees tested positive for narcotics, FRA concluded that this narcotics use was not a primary or contributing cause of the accident.

Analysis - Operating Practices: The PW Line is listed under the Mid-Atlantic Subdivision (MAD) of the Amtrak NEC that starts at MP 0.0 Philadelphia, and runs to MP 134.6 at Control Point (CP) Avenue Interlocking, Union Station, Washington, DC. The maximum authorized timetable speed is 110 mph on Main Track Number 3 for Amtrak equipment involved at the location of the accident, in particular, between CP Baldwin and CP Hook Interlocking.

An Automatic Block Signal System governed train movements. Specifically, a signal system governed with the use of each block by an automatic block signal, cab signal, or both, and Advanced Civil Speed Enforcement System (ACSES) and/or Positive Train Control (PTC). In addition, the Dispatcher issues a Form D to restrict or authorize movements and a Form D to convey instructions in situations not covered in the Operating Rules. The signal system and use of Form Ds are controlled by the Dispatcher from the Movement Office CETC (Consolidated Electrification and Train Control System) at Wilmington, Delaware. Train movements, main track occupancy and Dispatcher oversight responsibilities applicable to track authority is governed by the Northeast Operating Rules Advisory Committee (NORAC) Tenth Edition, effective on November 6, 2011, and Amtrak NEC Timetable/Special Instructions General Order Number 601, effective February 22, 2016.

In addition, publication of special books and manuals for unique handling, to include Dispatcher, Engineer, Conductor, and other train crewmembers.

- Temporary Speed Restrictions, effective 5:00 a.m. Sunday, April 3, 2016
- Bulletin Order Number NYW6-06, effective 12:01 a.m., Monday, March 28, 2016
- Supplemental Bulletin Order Number NYW6-01SCH, effective 12:01 a.m., Monday, February 22, 2016
- Summary Bulletin Order Number NYW6-03SUM, effective March 7, 2016

- Summary Notice Number 6-S05, effective April 1, 2016
- Train Handling Instructions (AMT-3)
- Special Instructions Governing Operation of Signals and Interlockings (AMT-4)
- NEC Train Dispatcher's Manual of Instructions
- MAD Train Dispatcher's Manual Sections

Employee Training, Qualification and Certification - Applicable to 49 CFR Parts 240 and 242 and Section 217.9, train crew members and the Dispatcher received initial, periodic training and passed the applicable examination to be deemed qualified. The Engineer and Conductor were certified prior to the accident.

The last medical examination for the 47-year old Engineer was on June 10, 2015, and he wore prescription glasses at the time of the accident. During the post-accident interview with investigators, he stated, he "had no health issues and my overall health is good." He also stated that he felt alert when he went on duty Sunday morning.

The Engineer began his railroad career with NJ Transit (NJT) as a student Engineer in 1999. He was hired with Amtrak in May 2014, began training for Locomotive Engineer, and was promoted in June 2015. The Engineer was familiar with the line of sight (physical characteristics) on the PW Line where the accident occurred and worked the extra board.

Engineer certification sequence and examination dates prior to the accident:

- Train Service Engineer Efficiency Test (FRA 303) 03/14/2016 Pass
- Train Service Engineer Medical Examination 06/10/2015 Pass
- Train Service Engineer Last Skills Performance/Monitoring Ride 01/07/2016 Pass
- Train Service Engineer Knowledge Test 01/19/2016 Pass
- Train Service Engineer Prior Employment Review 05/21/2015 Pass
- Train Service Engineer Hearing Examination 06/10/2015 Pass
- Train Service Engineer Vision Examination 06/10/2015 Pass
- Train Service Engineer Operating Rules (FRA 125) 01/20/2016 Pass
- Train Service Engineer State Review 04/28/2015 Pass
- Train Service Engineer NDR Review 04/30/2015 Pass
- Train Service Engineer EAP Review 04/30/2015 Pass
- Train Service Engineer EAP Review 04/30/2015 Pass

The Section 4 first shift Dispatcher complied "in part" with the applicable rules of procedure (i.e., transfer, documentation, hours of service (HOS), blocking devices applied and removed), except during the issuance and cancellation of Form Ds. The Dispatcher used a telephone instead of the radio when the Dispatcher issued and cancelled the mandatory directives to the Foreman-in-charge when they received, copied and repeated the Form Ds in their entirety. In addition, after the Dispatcher verified the accuracy, he then issued the time effective again over the telephone instead of the radio.

Conclusion - Operating Practices: HOS documents demonstrated compliance with the HOS Regulations and Amtrak 89 was governed by the Dispatcher and operated by the train crew in compliance with NORAC Operating Rules, Timetable and Special Instructions, special publications and procedures. Both the Engineer and the Conductor were properly certified.

The train crew was compliant with 49 CFR §§ 240.117(e)(1)–(5) and 242.403(e)(2)(ii), (3) up to the accident.

However, the Section 4 Dispatcher failed to use the radio when issuing mandatory directives, Form D A1401, and cancellation of Form D A1403, as required by 49 CFR § 220.61(a). This failure was contributory to the accident.

Analysis - Signal and Train Control: A post-accident investigation beginning on April 04, 2016, involving the NTSB, FRA, and Amtrak, centered on the route Train 89 traveled between CP Baldwin located at MP 11.70, and CP Hook located at MP 16.80 on the MAD Subdivision of the NEC. The investigation began at CP Baldwin (MP 11.70) to the accident site north of CP Hook (MP 16.80), including the automatic signal locations 127 (MP 12.70) and 141 (MP 14.10).

Investigators inspected all locations, verified associated track circuits, and shunted and tested for proper cab signal current, frequency, and code rate. Investigators inspected and verified all signal locations were free of grounded circuits and all signal lamp units were working as intended with proper voltage levels. Investigators performed signal sequence testing between Baldwin and Hook interlocking, including automatic signal locations 127 and 141. Investigators verified all signal aspects and the cab signal frequency at all locations. Investigators verified the cab signal code change points and high-speed cab signal code change points were working as intended. Investigators inspected all periodic test reports covering the wayside signal equipment required by 49 CFR Part 236 for the past 12 months and found no defects for the units inspected.

Investigation of the ACS-64 Locomotive 627 on the day of the incident showed proper placement of all Cab Signal and ACSES seals and all Cab Signal and ACSES on-board test documents complied with 49 CFR Part 236. Due to the impact on the front-end of the locomotive, the cab signal receiver units were bent and damaged.

Conclusion - Signal and Train Control: All testing and inspections revealed no abnormalities that would contribute to the train accident. There was no damage sustained to the right-of-way signal equipment.

Analysis – Locomotive Event Recorder Download:

- 7:49:39 a.m.: Train speed 106 mph
- 7:49:41 a.m.: Engineer Initiated Emergency Brake Application
- 7:49:44 a.m.: Point of collision 102 mph
- 7:49:46 a.m.: End of data 99 mph

The event recorders failed to record/store any data after the initial impact with the backhoe.

The speeds and times referenced in this section are taken from Locomotive ATK 627's event recorder.

The data was gathered, secured, analyzed and tested by Amtrak and the NTSB. FRA was provided with a copy of the download. The event recorder met the standards of 49 CFR

§ 229.135 (i.e., (i) Train speed; (ii) Selected direction of motion; (iii) Time; (iv) Distance; (v) Throttle position, selected direction of motion (vi) Applications and operations of the train automatic air brake; (vii) Applications and operations of the independent brake; (viii) Applications and operations of the dynamic brake, if so equipped; and (ix) Cab signal aspect(s), if so equipped and in use)).

Conclusion – Locomotive Event Recorder Download: Amtrak authenticated data from the event recorder and demonstrated accurate information. FRA and Amtrak validated train handling methods and compliance with maximum authorized speed demonstrated by the Engineer. The Engineer's operation of the locomotive was not a contributing factor to the accident.

Siemens Engineers assisted in the investigation and determined that the recording failure at 7:49:46 a.m.

was caused by a loss of power to the event recorder because of the collision. Siemens Engineers are looking for a solution to the failure by connecting the event recorder to another power source or protected circuit.

Analysis - Locomotive and passenger car consist validation: Amtrak 89 consisted of one controlling locomotive, eight passenger coaches, one café car, and one baggage car. The train weighed approximately, 1,172,000 pounds (586 tons) and was about 912 feet in length.

Sequence - Car Type - Number – Capacity

1. 1 - Locomotive - 627 - 2 (plus 1 jump seat)
2. 2 - Business Coach - 82993 - 72
3. 3 - Passenger Coach - 82524 - 70
4. 4 - Passenger Coach - 82781 - 72
5. 5 - Passenger Coach - 25034 - 59
6. 6 - Passenger Coach - 25040 - 59
7. 7 - Passenger Coach - 25088 - 59
8. 8 - Café Car - 43364 - 0
9. 9 - Business Class Car - 81543 - 62
10. 10 - Baggage Car - 61028 - 0

(Table 1-Train 98 consist)

Conclusion - Locomotive and passenger car consist validation: All of the above passenger coaches and the locomotive were properly identified, classified, and documented as the equipment involved in the accident and subsequent derailment.

Analysis – Train Equipment Pre-Accident Inspection: Amtrak 89 originated from Penn Station powered by Amtrak Locomotive 627, received and passed a Class 1 brake test by a qualified mechanical inspector.

Conclusions –Train Equipment Pre-Accident Inspection: Train 89 received and passed all FRA-required pre-departure tests.

Analysis – Train Equipment Post-Accident Inspection: FRA, the NTSB, Amtrak, and Siemens formed a mechanical group of qualified inspectors to inspect the condition of all involved equipment. Amtrak towed the equipment from the accident site to the 30th Street Station in Philadelphia where the inspection was completed. Parties of the investigation documented locomotive and car damage.

Conclusion - Equipment Post-Accident Inspection: The group took no exception to any mechanical defects.

Analysis - Amtrak Locomotive 627 and Coach 82993: A comprehensive inspection was completed and no mechanical defects were found.

Conclusion - Amtrak Locomotive 627 and Coach 82993: Locomotive 627 received extensive front-end damage because of the collision. The first coach located behind the locomotive (82993) received moderate damage to the right side exterior shell and side windows. It appears a portion of the backhoe struck the side of the cars during the collision and caused the damage.

Analysis - Emergency Lighting and Public Address (PA) System: The emergency lighting system was functioning as intended upon inspection. The PA System lost communication to several of the coaches post-accident due to damage from the backhoe striking the first coach and damaging the wiring system.

Conclusion - Emergency Lighting and PA System: The emergency lighting system operated as designed and intended. The PA system failed to operate in several coaches because of post-accident damage.

Analysis - Wheel inspection, Brake rigging, Brake shoes, Brake pads, and Discs: Inspectors examined all of the involved components of the wheels and braking system on Train 89.

Conclusion - Wheel inspection, Brake rigging, Brake shoes, Brake pads and Discs: All components of the braking system and wheels were compliant with Federal regulations. Several application and release tests were conducted with the assistance of an Amtrak machinist and no exceptions were taken.

Analysis - Alerter Test on Locomotive 627: The loss of power in the front-end prevented alerter testing on the F-End due to the collision.

Conclusion - Alerter Test on Locomotive 627: The accident team tested the alerter system on the B-end and it operated as intended and designed.

Analysis - Amtrak Locomotive 627 Cab signal and Advanced Civil Speed Enforcement System (ACSES):

The locomotive is equipped with an automatic train control (ATC) system. The system is a combined 9-Aspect ATC and ACSES configuration that ensures safe operation of the locomotive. The ATC portion of the system includes Automatic Speed Control (ASC) and Automatic Train Supervision (ATS) capabilities.

The ASC feature protects the locomotive from exceeding speed limits established by track signals. The ATS feature ensures that the Locomotive Engineer recognizes and acknowledges track signal (aspect) downgrades. A downgrade is a signal change that becomes more restrictive. The ACSES portion of the system includes civil speed enforcement and Positive Train Stop (PTS) enforcement capabilities. The civil speed enforcement feature of ACSES protects the locomotive from exceeding civil speed limits.

Amtrak establishes civil speed limits based on the presence of permanent and temporary wayside transponders. The PTS enforcement feature ensures that the locomotive stops at home signals when an absolute stop aspect is present. FRA requires daily ATC and ACSES departure tests no later than every 24 hours. Each test must be conducted or verified by the Locomotive Engineer or Qualified Mechanical Person prior to the day's initial service run.

Conclusion - Amtrak Locomotive 627 Cab signal and Advanced Civil Speed Enforcement System

(ACSES): All systems on the locomotive worked as designed. The ACSES system was functional on Track 3 where the train was operating. Inspectors took no exception to the findings.

Analysis – Track: The PW Line consists of four main tracks. Amtrak numbers their tracks from east to west Main Track Number 1, Number 2, Number 3, and Number 4. Amtrak operates and maintains Main Track Numbers 2 and 3, near the accident as FRA Class 6 with a maximum authorized timetable operating speed of 110 mph for passenger trains. Amtrak operates and maintains Main Track Numbers 1 and 4, near the accident as FRA Class 5 with a maximum authorized timetable operating speed of 90 mph for passenger trains. On Main Track Numbers 2 and 3, there is virtually no freight traffic. Amtrak estimates the gross annual tonnage at 23-25 million gross tons (MGT) for Main Tracks Number 2 and 3 and 17-19 MGT for Main Track Numbers 1 and 4. Approaching the accident site in the south direction, the train traversed track with an ascending grade from MP 12 to MP 13.8, where the grade varied from 0.14 percent to 0.41 percent. At MP 13.8, the grade descends to MP 14.25 at 0.55 percent. From MP 14.25 to MP 14.45, the grade is nearly level. At MP 14.45, the grade is ascending at 0.40 percent and plateaus at MP 14.8. From MP 14.8 to 15.55 the track is level. Starting at MP 15.55 the track has a descending grade that varies from 0.14 percent to 0.47 percent up to MP 16.6. The alignment of the

track is tangent from MP 15.0 to MP 15.8. All four main tracks are constructed with continuous welded rail fastened to concrete crossties on 24-inch centers with Pandrol elastic fasteners. The track centers measured about 13 feet.

Investigators observed wheel flange marks departing the west rail down the gage face of the railhead to the base of the rail and trailing southward as those marks angled towards the center of the concrete crossties. A companion set of marks were observed where flange marks went up and over the east head of the rail and dropped outside to the field side of the east rail. The marks trailed southward and angled away from the on-track material towards the outside edge of the concrete crossties. The Engineering department investigation team established the point of derailment (POD) at MP 15.69, or about halfway between the POI and the center of the Booth Street undergrade bridge. Amtrak Locomotive 627 was the only rolling stock derailed and it came to rest upright approximately 2,510 feet from the POD.

Amtrak conducted track geometry car tests over the NEC twice a month. Amtrak conducted the last geometry inspection on March 16, 2016. Amtrak's geometry car found no defects in the derailment area for the March 16 test.

Amtrak conducted track inspections over the NEC twice a week. The last walking track inspection was conducted on March 31, 2016. Amtrak's track inspector found no track defects in the derailment area on his March 31 inspection of Main Track Number 3.

Conclusion – Track: Amtrak found no geometry defects during the post-accident inspection and the prior Geometry Car and walking inspections did not find any exception near the POD. There are no indications of any rail or track defects that would be a cause or contributing factor in this derailment.

Analysis - Roadway Worker Groups

Training and Certification: FRA reviewed Amtrak's training for roadway worker protection (RWP) following the accident. FRA determined Amtrak's RWP training was conflicting with Special Instruction 140-S2 for SSD. Amtrak's Special Instruction 140-S2 states that an SSD must be applied in signal pockets. However, the 2015 RWP PowerPoint training slide involving an SSD states an exception that an SSD is not required in signal pockets. Amtrak also revised the RWP manual in 2015 and removed pages that mentioned application of SSDs.

The Night Foreman, Assistant Track Supervisor, and Backhoe Operator were qualified in RWP and NORAC Rules. The Night Foreman had physical characteristic qualifications between the Baldwin and Hook Interlockings. The Trackman and Day Watchman were both RWP-qualified and the three Loram contractors were current with their Amtrak-required contractor certification.

The Day Foreman, Track Supervisor, and Trackman were qualified in RWP and NORAC Rules. The Day Foreman had physical characteristic qualifications between Baldwin and Hook Interlockings.

Job Briefings:

When an Amtrak employee or contractor (roadway worker) is assigned a duty that calls for that employee to foul a track, an on-track safety job briefing must be provided prior to starting any work or fouling any track. A job briefing is a meeting conducted prior to going to work. During the job briefing, the work gang meets to discuss all aspects of the work to be performed and any safety-related concerns. Anyone can conduct a job briefing. However, the Roadway Worker in Charge (RWIC) traditionally holds the on-track safety briefing. A job briefing for on-track safety shall be deemed complete only after the roadway worker has acknowledged understanding of the on-track safety procedures and instructions presented.

The Day Foreman interview with the NTSB and FRA revealed that the Day Foreman did not conduct a job briefing with employees who were fouling tracks. He had some of the employees and contractors sign the “on track safety briefing sheet” without a job briefing. The Day Foreman explained that this was a preliminary job briefing and a proper job briefing was pending.

These safety items were specifically listed on the “on track safety briefing sheet” (Form NRPC 3044) for the night and day shifts: “If foul time is being used will the SSD’s be applied?” and “Are the whistle boards up?” FRA determined that these two major safety items were not properly addressed in the job briefing.

Amtrak Special Instruction 140-S2 states, in part: “This instruction requires the employee in charge of ‘covered fouling activities’ to apply an approved SSD to the track(s) to be fouled, after receiving foul time from the Dispatcher or Operator. The purpose of the SSD is to supplement, not replace, blocking device protection provided by the Dispatcher or Operator.

1. Covered Fouling Activities: Except as noted below, this instruction applies when equipment will be used to foul a track in signaled territory or within interlocking limits for more than 5 minutes.

An SSD is a device used to provide positive shunt through track occupancy with documented verification to the Dispatcher.”

The backhoe and the Loram Vacuum Unit consistently fouled track during both shifts in signaled territory for more than 5 minutes. These actions required the RWIC to apply SSDs. However, on April 2, and April 3, the RWIC/Foreman did not apply SSDs and checked the “no” box of their “on track safety briefing sheet” on the line that states, “If foul time is being used will the SSD’s be applied?”

The Amtrak Roadway Worker Protection Manual, dated January 2015, Rule 339 (1) – “Portable Whistle Board Use” states, in part: “signs are to be used by roadway work groups of five (5) persons or more when the duration of work exceeds 1-hour. With groups of less than five (5) people, the signs are optional.

Portable whistle boards are signs that roadway workers apply to the track that require trains to provide audible warning.”

The night and day shifts of this 55-hour outage had work groups of more than five persons and the duration was over 1-hour. These activities required the RWIC to apply whistle board signs in advance of the work site. However, on April 2, and April 3, the RWIC did not apply whistle board signs and checked the “no” box of their “on track safety briefing sheet” on the line that states, “Are the whistle boards up?”

Radio and Cell Phone Use:

FRA investigation of the MOW employees working on the 55-hour outage revealed that the RWIC and the roadway workers were using the radios to communicate throughout the night on April 2, and April 3, 2016. There were a few occasions where the Dispatcher and the RWIC were having difficulties communicating with each other and resorted to using cell phones.

On April 3, 2016, the Day Foreman came on duty and used his company cell phone to obtain his exclusive track occupancy (Form D) on Main Track Number 2 from the Dispatcher. The Night Foreman also used his personal cell phone to cancel his Exclusive Track occupancy on Main Track Number 2 and to cancel his foul time on Main Track Numbers 1, 3, and 4 with the Dispatcher.

The title of Amtrak system Special Instruction 716-S2 is “Use of Telephones for Employees Involved in Main Track Authorities and Mandatory Directives.” It states that:

“Telephones must not be used in lieu of radio communication to obtain or release main track authorities or to copy mandatory directives. Where radio communication is not possible, a telephone may be used to obtain or release main track authorities or to copy mandatory directives.

1. Before using a telephone to obtain or release a main track authority or copy a mandatory directive, all crew members must participate in a job briefing and agree that it is safe to do so.
2. Immediately after obtaining main track authorities or copying a mandatory directive, all crewmembers must again participate in a job briefing to properly disseminate information from that communication.
3. Before reporting clear or releasing a main track authority, all crewmembers must participate in a job briefing to ascertain and agree on the exact location that their entire train has passed, and that it has cleared the affected limits.”

The Day Watchman:

FRA and the NTSB interviewed the day shift Watchman on April 5, 2016. During the interview, he stated that he arrived at the work site around 7:00 a.m. The Night Foreman provided the Day Watchman a job briefing and he relieved the Night Watchman. He positioned himself on the west side of Main Track Number 4 directly across from the backhoe. At 7:50 a.m., the Day Watchman stated that he saw Amtrak 89 and signaled for the approaching train using an air horn and orange disc raised above his head. As the train got closer, he realized the train was on Main Track Number 3, the same track as the backhoe and frantically attempted to warn the workers of the approaching train.

However, the outward-facing camera from Amtrak 89 demonstrated that the Day Watchman did not raise the orange disc above his head as required and did not attempt to warn workers of the approaching train.

The Night Foreman:

On April 3, 2016, at 7:28 a.m., the Night Foreman canceled his exclusive track occupancy (Form D Number A1403) on Main Track Number 2. At 7:29 a.m., the Night Foreman canceled his foul time on Main Track Numbers 1, 3, and 4. The Night Foreman canceled these track authorities using his personal cell phone with the backhoe still fouling Main Track Number 3.

The NTSB and FRA interviewed the Night Foreman on April 7, 2016. He stated that he saw the equipment fouling Main Track Number 3 when he canceled his foul time on the track. He stated he believed the Day Foreman would acquire the foul time on Main Track Number 3 shortly after he canceled his foul time.

Conclusion - Roadway Worker Groups

Training and Certification:

Amtrak RWP training was found to have contradicting statements between their training and special instruction. In addition, in an effort to simplify their RWP manual, they removed mention of SSDs from the manual. Since the work site was not inside an interlocking and both RWIC were qualified on NORAC Rules and RWP rules, these exceptions were not contributing factors to the accident.

All Amtrak employees and Loram contractors were fully qualified for their assigned jobs. Training and certification was not a factor in the accident.

Job Briefings:

The Day Foreman became the RWIC of the work gang when he received his Form D for Main Track Number 2 at 7:26 a.m. on April 3, 2016. Therefore, he was required to conduct a job briefing before any workers or equipment fouled the track. This failure to conduct a job briefing was a contributing factor to

the accident.

Failure of the Night and Day Foremen to apply SSDs and portable whistle board signs are contributing factors to this accident. If an SSD was applied and the Night Foreman gave his foul time back to the Dispatcher with equipment still on the tracks, a track occupancy light would be displayed on the Dispatcher's console and prevent train movement through that segment of track.

If Amtrak placed portable whistle board signs, Amtrak 89 would have been required to provide audible warning in the form of a train whistle/horn. This advanced warning would have given the work gang an added safety factor and possibly more time to react to an approaching train.

Radio and Cell Phone Use:

Effective radio communication was possible using radios located on the backhoe, Loram Vacuum Unit or portable radios issued to all RWICs. Amtrak special instructions require the use of radios to obtain and release main track authorities and mandatory directives.

These failures were a contributing factor to the accident.

The Day Watchman:

The Day Watchman's failure to be attentive to his Watchman duties was a contributing factor to this accident. The Day Watchman failed to provide train approach warning for roadway workers, as required by Amtrak's RWP Rule 329(a)(4) and 49 CFR § 214.329(a).

The Night Foreman:

The Night Foreman canceled his foul time with equipment still in the foul on Main Track Number 3. He did not notify affected roadway workers that the protection had changed. The Night Foreman's failure to release working limits without notifying roadway workers, as required by 49 CFR § 214.319(c)(1), was a contributing cause of the accident.

Overall Conclusions

Human factor elements of the train crew with regard to rest periods and fatigue were analyzed and no exceptions were taken.

FRA's post-accident investigation of the train crew and dispatchers was current with regard to physical and test exams, training and certification.

Operation of Amtrak 89 from Penn Station to the POI in Chester, was compliant. Train speed remained within the maximum authorized speed listed in Timetable No. 6.

All testing and inspections of Signal and Train Control revealed no abnormalities that would contribute to the accident. The inspection of the signal system included records of tests and maintenance performed prior to the accident that indicated the signal system was working as intended.

FRA's post-accident investigation of Locomotive 627 and the attached cars found no mechanical defects. In addition, investigation of mechanical test records, inspections and maintenance performed prior to the accident revealed no contributing cause.

Measurements of the post-accident track geometry and a review of previous automated track geometry records near the derailment site demonstrated that the track geometry was compliant.

A review of Amtrak's track inspection reports, periodic inspection reports and rail inspection records indicated that Amtrak complied with the frequency of the required inspections, the reporting of exceptions and taking the required remedial action in a timely manner.

FRA's post-accident investigation, along with the NTSB/FRA's interviews and outward-facing camera

footage of the RWP on April 2, and 3, 2016, revealed several noncompliant actions taken by the Day Foreman and Night Foreman as well as the Day Watchman.

FRA found Amtrak's on-track safety briefing sheets for April 2 and 3, to be incomplete. SSDs were not mentioned as required by Amtrak special instructions during the briefings. Portable whistle board signs were not mentioned as required by Amtrak special instructions during the briefings. These two items were contributing factors to the accident.

The NTSB/FRA's interviews revealed that the Day Foreman did not hold a job briefing. Employees signed the Day Foreman's job briefing sheet without receiving an on-track safety briefing.

FRA's post-accident investigation of the Dispatcher's phone and radio recordings revealed that on April 3, 2016, the Day and Night Foremen used cell phones to receive and cancel their exclusive track occupancy and foul time. Since the Backhoe Operator and the Loram Vacuum Unit had working radios in their cabs and were found to be actively monitoring the Amtrak radio channel, this became a contributing factor to Amtrak 89's collision with the backhoe.

The investigation of the outward-facing camera revealed that the Day Watchman was not attentive to his duties and failed to raise his Watchman's orange disc at the approach of Amtrak 89. This failure was a contributing factor to the fatal injuries to the Track Supervisor and Backhoe Operator.

The post-accident interview with the Night Foreman revealed that he canceled his foul time in view of equipment still in the foul on Main Track Number 3. This event was a factor contributing to the primary cause of the collision.

Probable Cause

FRA's investigation determined that the cause of the accident was due to an MOW backhoe that was fouling Track Number 3 without working limits as required under 49 CFR § 214.319 and referenced by FRA Train Accident Cause Code M404 (Object or equipment on or fouling track).

Contributing Factors are listed below and referenced by FRA Train Accident Cause Code M399 (other causes):

1. Failure of MOW Foreman to apply a SSD in accordance with Amtrak Special Instruction 140-S2.
2. Failure of MOW Foreman to apply whistle board signs at the work location in accordance with Amtrak Roadway Worker Protection Manual Rule 339(1).
3. Failure of MOW Foreman to use radio when canceling foul time in accordance with 49 CFR § 220.61(a).
4. Failure of MOW Watchman to raise orange disc on approach of train in accordance with Amtrak Roadway Worker Protection Manual Rule 329(a)(4).
5. Failure of MOW Foremen to provide a job briefing for on-track safety in accordance with 49 CFR § 214.315(b).