

NATIONAL TRANSPORTATION SAFETY BOARD

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

RRD19FR004

SEPTA Roadway Worker Fatality

TRACK & ENGINEERING FACTUAL REPORT

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A. Accident:

NTSB Accident Number: RRD19FR009
Date of Accident: July 8, 2019
Time of Accident: 5:21 p.m. (Local Time)
Type of Accident: Roadway Worker Fatality
Railroad Owner: SEPTA
Train Operator: SEPTA
Type of Train and No: Broad Street Line Passenger Train
Crew Members: 1 Train Operator / 2 Roadway Workers
Location of Accident: Philadelphia, Pennsylvania

B. Track Group Party Members:

Troy Lloyd
National Transportation Safety Board
Track Group Chairman/Railroad Accident Investigator

Ron Benson
SEPTA
Director, Construction Safety

Dave Stump
SEPTA
Chief Track Officer

John Weisgerber, P.E.
TRA
Senior Director, Engineering

Bill Bannon
TWU 234
Vice-President

C. Accident Summary:

On Monday, July 8, 2019, about 5:21 p.m. local time, a northbound Southeastern Pennsylvania Transit Authority (SEPTA) train struck two SEPTA track workers in Philadelphia, Pennsylvania. As a result of the collision, one worker was killed, and the other worker was injured. The accident occurred on the Broad Street Line (BSL) at Erie Interlocking during the systems rush hour service time.

The two SEPTA workers, 1- track inspector¹ and 1- watchperson², who were both trained as qualified protection employees³ (QPE), was assigned by their line supervisor to conduct their regularly scheduled track inspection between Girard and Susquehanna, including an overtime assignment to conduct a detailed switch inspection at Erie Interlocking. Immediately after the employees completed their regular track inspection, they reported to Erie Interlocking to conduct their scheduled overtime assignment. The two workers arrived at Erie Interlocking and the track inspector who was the assigned QPE, elected to use train approach warning (TAW) as their form of on-track protection within the interlocking limits. The track inspector radioed the BSL train dispatcher at about 4:15 p.m. for permission to enter the track to conduct his switch inspections. The train dispatcher granted the permission and made an announcement over the radio that personnel were in the interlocking at Erie.

While performing his inspections, the track inspector discovered indications of lateral movement in a switch component (frog) on track 2 and decided to make some minor repairs by adding additional track spikes to minimize the movement. He notified his supervisor around

¹ Track Inspector- an employee who is trained and qualified to inspect track for defects.

² Watchperson- "The person stationed at the work area who is responsible for warning workers when a train is approaching".

³ Qualified Protection Employee (QPE)- "A SEPTA employee qualified on the operating rules, physical characteristics, and on track protection procedures and is responsible for establishing on-track protection and safety". On-Track Safety rules No. 21 (OTS-21) states that the QPE must determine the method of providing protection to be used according to the operating rules.

5:17 p.m. of his findings and recommendations to repair the switch component, the supervisor concurred with the inspectors' actions. As stated by the track inspector during his interview:

*"I was doing my switch inspection. 25, the switch, (inspector referencing the No. 25 North Switch) the frog was moving so we put a couple cut spikes in. And then the train on 3 track was at the platform, complete stop"*⁴.

After the minor repairs were completed, the inspector stated that he noticed a southbound train approaching from a distance on track 2, while the northbound train was still stopped on the platform at Erie Station on track 3. The inspector then directed the watchperson to hold the northbound train on track 3 at Erie Station while he monitored the southbound train moving over the minor track repairs on track 2. The inspector stated during interviews:

*"I told my partner, (referencing the watchperson) I want him to stop this train right here because the train was coming down 2 track. I'm going to watch the train go over, over the frog on 2 to see if we need to do anything else to it – to the frog"*⁵.

A review of the head-end video from the striking train shows the watchperson walk to the

⁴ Track Inspector interview, page 7; lines 8 - 11

⁵ Track Inspector interview, page 7; lines 12 - 15

south end of track 3, swinging a flashlight horizontally across the tracks in the direction of the train stopped on the platform on track 3 indicating a “stop signal” per SEPTA operating rules. Afterwards, the video shows the watchperson walking north with his back towards the train stopped on track 3. The video then shows the train departing northbound on track 3 from Erie Station. Seconds before impact, the two workers are shown standing side-by-side in the diamond area of Erie interlocking, fouling⁶ both tracks.



Figure 1- graphic taken from SEPTA's Rail Operations Division Rules Manual, RDR-11 Hand Signals.

[Alt. text: graphic taken from SEPTA’s Rail Operations Division Rules Manual, RDR-11 Hand Signals.]

D. Line Description:

Broad Street Subway Line (BSL):

The Broad Street Line (BSL) consists of all subterranean private right-of-way, except for Fern Rock Terminal/ Yard. The line consists of eleven miles of both double track and four track subway between the Fern Rock station (the only portion of the line not in the subway) located in

⁶ Fouling- being in a position to be struck by moving on-track equipment.

North Philadelphia and the NRG station located in South Philadelphia. Additionally, a 2-mile branch line runs from Broad and Girard Streets, to 8th and Market Streets under Ridge Avenue, and is known as the Broad-Ridge Spur. The annual ridership on the Broad Street Line was about 36.4 million in FY 2018. The BSL consists of twenty-five passenger stations, including the terminals. Twenty-four stations are located below ground in the subway system and one station is located above ground.

The line operates seven days a week, from approximately 5:00 am until 1:00 am. The line operates express service on tracks 2 and 3 between Fern Rock Transportation Center and Walnut-Locust Station, and local service on tracks 1 and 4 between Fern Rock Transportation Center to NRG Station. The four-track territory ends at Walnut-Locust Station and only two tracks continue down to NRG Station. The Ridge-Spur service runs local service on track 1A and 4A on a 7-minute peak and 20-minute off peak headway. Train consist lengths are typically operated with five cars; Broad-Ridge Spur trains are operated with two cars. Overnight service is provided on Saturday and Sunday.

Track locations or addresses along on the BSL are defined by the direction and distance from Philadelphia City Hall. The first field in the location is a single character and will be an “N” or “S” defining north or south of City Hall. The second field is the number of city blocks from City Hall and the third field is the number of bents from the cross street. A bent is the cut-out in the wall and are approximately 5 feet long. For example, the track location for this particular accident is identified as N 37-85. “N” indicates north of City Hall, 37 is the number of blocks from City Hall to Erie Avenue (the cross street) and 85 is the number of bents.

E. Erie Station Description:

Erie Station is located at milepost (MP) 2.82 and is situated between the Allegheny and Hunting Park Stations. At Erie Station, the line is configured with four stations tracks; track 1 is the local southbound track, track 2 is the express southbound track, track 3 is the express northbound track and track 4 is the local northbound track. A station platform is constructed between tracks 1 and 2 and between tracks 3 and 4 to accommodate passenger service. The maximum authorized speeds (MAS) between Olney and NRG stations is 50 mph on tracks 1 and 4, and 70 mph on tracks 2 and 3. Except when expressing through all passenger stations on all four tracks, the MAS is 30 mph.

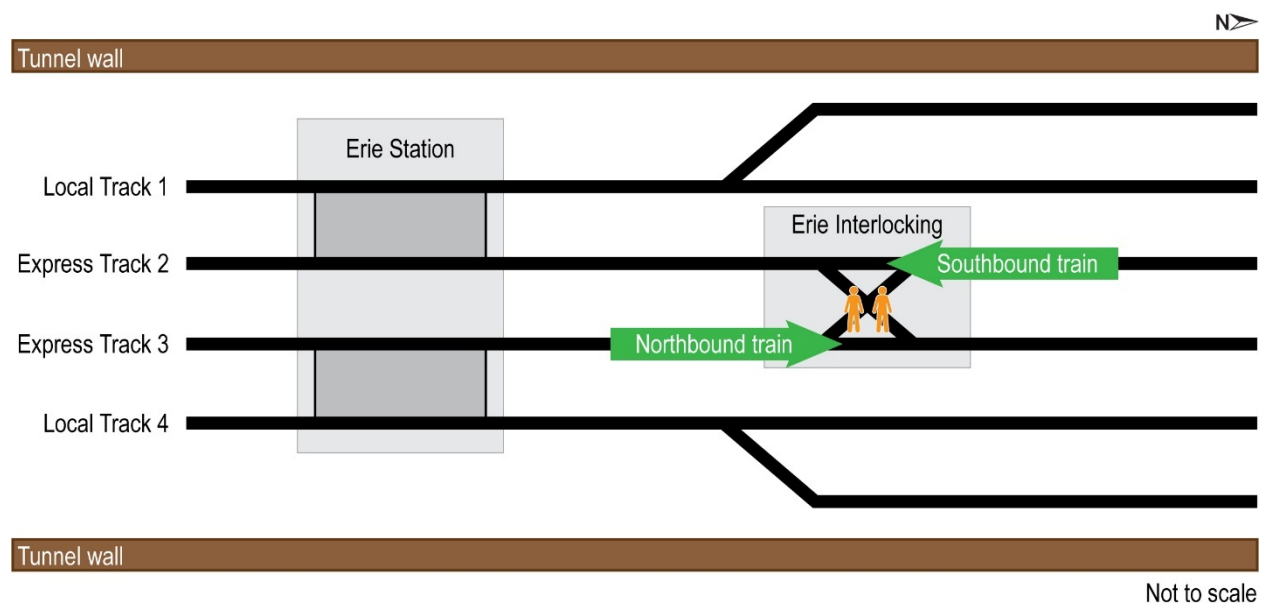


Figure 2- graphic shows the accident site layout of the tracks, Erie Station and Erie Interlocking.

[Alt. text: This is a graphic that shows the layout of the tracks at the accident site in Erie Interlocking. Starting at the top of the graphic and working down shows Local track 1, Express track 2, Express track 3, and Local track 4 (Express tracks 2 & 3 make up Erie Interlocking). The graphic also shows two connecting tracks from Local tracks 1 and Local track 4. In the center of the graphic is the layout of Erie Interlocking with two track workers standing in the center with green colored arrows placed

over tracks 2 and 3 indicating the approaching trains, and direction of travel.]

F. Erie Interlocking Description:

Erie Interlocking⁷ was constructed in 1957 per SEPTA drawings and is described as a direct fixation⁸ number 8 size double cross-over (interlocking) with a center diamond. Trains are powered by 600 volt- direct current (VDC) electrified 3rd rail. The interlocking is located in the underground portion of the Broad Street Line (BSL) with no natural lighting. Lighting in the interlocking is supplied through mounted high-pressure sodium light fixtures that produce a dim orange tinted light. Express Tracks 2 and Express Track 3 configure the double crossover portion of Erie Interlocking, with Local track 1 and Local track 4 operating as through tracks to the outside of the double crossover (see figure 2). Trains operating through the interlocking on tracks 2 and 3 have a MAS of 70 mph, with diverting crossovers moves at 15 mph. Local tracks 1 and 4 have a MAS of 50 mph. The track centers measured between Express track 2 and Express track 3 at the center diamond area of the interlocking (accident location) averaged 13 feet. The total track length of the interlocking is 229 feet.

Regular track inspections, including interlockings are inspected weekly as required per SEPTA's track inspection requirements, but detailed switch and turnout inspections (special track work inspections) are conducted at least monthly per SEPTA's switch inspection requirements.

Erie Interlocking is constructed of wood switch timbers measuring 9.5 inches by 7.5 inches, by various non-standard lengths. The wood switch timbers are bolted to a concrete invert

⁷ An interlocking is an arrangement of switches and signal appliances that controls and directs train movements from one track to another track.

⁸ Direct fixation- meaning built on a concrete floor, invert or foundation.

and are secured with one anchor bolt to prevent tie lateral and vertical movement. Third rail insulator support ties are spaced every ten feet to support track and cross-level gauge and to also support the weight of the powered contact rail and 3rd rail insulators. The running rails within the interlocking sit directly on the crossties with no crosstie plates installed between the top surface of the ties and bottom surface of the running rail. The running rails are secured to the ties with lag bolts and Type C/D fasteners⁹.



Figure 3 shows Local track 1 at Erie interlocking and the Type B track construction.

[Alt. text: This photo shows a series of rail connections and crossties that make up the construction of Erie Interlocking. The photo shows the walking and tripping hazards created by the non-standard crosstie measurements and deep voids below and between the crossties.]

⁹ Type C/D fasteners is a type of hold down device that secures the rails in place to the crossties.

G. Track Inspection Criteria:

Track inspections are conducted once a week on the Broad Street Line in accordance to SEPTA's SMW-100¹⁰; procedure No. 213.233(c). Each track inspection shall be made in accordance with the following schedule-

Type of track	Required frequency
Main track and sidings including street tracks	Weekly with at least 3 but no more than 11 calendar days interval between inspections, or before use, if the track is used less than once a week.
Interlocking Inspections	Mainline switches- at least monthly

H. Accident Track Measurements:

Investigators took track gauge and cross-level measurement at every 5th crosstie (10 feet stations) between the berthing location for a two-car train at the platform (N-37-10) and past the point of impact (N-37-90). The distance from the train berthing location to the point of impact is 385 feet. The train travelled 436 feet after the impact.

Track #	Station	Gauge (inches)	Crosslevel (inches with east rail positive)	Comments
2	0	56 1/2	0"	Platform 2/3 train car berth
2	1	56 3/8	0"	

¹⁰ SEPTA SMW-100 is a manual consisting of track maintenance and inspection techniques, procedures and standards.

2	2	56 7/16	0"	
2	3	56 7/16	0"	
2	4	56 5/16	0"	
2	5	56 1/2	0"	
2	6	56 1/2	1/8"	
2	7	56 1/2	0"	
2	8	56 1/2	0"	
2	9	56 3/8	0"	
2	10	56 1/2	0"	
2	12	56 1/2	0"	
2	14	56 3/8	1/4"	
2	16	56 7/16	0"	
2	18	56 7/16	0"	
2	20	56 1/2	1/16"	
2	22	56 3/16	0"	
2	24	56 7/8	0"	
2	26	56 1/8	0"	
2	30	56 1/4	0"	
2	38	56 1/2	1/8"	
2	40	56 1/2	-1/16"	
2	42	56 3/8	1/4"	
2	44	56 1/8	0"	
2	46	56 3/8	0"	
2	48	56 9/16	1/4"	
2	50	Frog	0"	Point of impact (diamond) 385 feet
2	52	56 1/2	0"	

2	54	56 1/2	0"	
2	56	56 3/4	0"	
2	58	56 1/2	0"	
2	60	56 5/16	0"	
2				Train Stopped location at 821 feet from 0 tie

I. Sight Distance and Hand Signal Observations:

Investigators performed an RWP sight distance and hand signals observation at the accident site to determine roadway worker sight distances and hand-signal visibility.

Investigators calculated that with a maximum authorized speed of 70 mph, the roadway workers required a minimum of 1,540 feet of sight distance in order to achieve the minimum 15 second warning and clearing time.

1. Roadway Worker Sight Distances:

Investigators conducted a sight and flashlight signal distance testing to determine compliance with SEPTA train approach warning protection rules. This test was also conducted to determine 1) the visibility and clarity of hand signals given by flashlight at the accident scene and 2) how the headlights from the approaching southbound train on track 2 affected the visibility of the northbound train operator on track 3.

From the point of impact, investigators measured and marked the required 1,540 feet of sight distance on tracks 2 and 3. Investigators then had the trains operate towards the marked distance locations with instructions to stop when investigators first detected the approaching trains.

- Southbound train approaching on track 2 was first detected by investigators 2,500

feet away from the accident site.

- Southbound train operator from 2,500 feet away detected the investigator giving a stop signal with a SEPTA issued flashlight in the interlocking.
- Northbound train (striking train) approaching on track 3 was first detected by investigators 2,500 feet away from the accident site.
- Northbound train operator from 2,500 feet away detected the investigator giving a stop hand signal with a SEPTA issued flashlights in the interlocking.

The final observation took place by moving the southbound train on track 2 to near the point of impact, and then having the northbound train on track 3 proceed into the interlocking from the station. The findings were that the headlights from the southbound train on track 2 totally obstructed the visibility of the operator of the train on track 3. This confirmed the forward-facing video footage recovered from the northbound train. **J. SEPTA's On-Track Safety:**

SEPTA's On-Track Safety Manual, 4th Edition, dated Effective, Sunday, November 1, 2015; describes the following:

- *On-Track Safety Points:*
 1. Never foul a track unless it's necessary in the performance of your duties.
 2. Always conduct a job safety briefing before beginning work.
 3. Conduct a follow-up job safety briefing whenever work conditions change.

4. Know and understand how on-track safety is being provided.
 5. You have the right to challenge any directive that violate an on-track safety rule.
- *Authorized Methods of Establishing On-Track Protection:*
 1. Train Approach Warning (watchperson / lookout)
 2. Foul Time
 3. Establish a Work Zone on an in-service track
 4. Remove a track from service
 5. Individual Train Detection (lone worker only)
 - *Manual Definitions:*
 1. Train Approach Warning (TAW)- *“A method of providing on-track protection for a work group in which a watchperson(s) is positioned in such a manner to provide warning of an approaching train or equipment”.*
 2. Roadway Worker- *“An employee, or an employee of a private contractor, who is engaged in inspection, construction, maintenance, or repair of track or facilities who has the potential to foul a track. Roadway workers include individuals who repair or maintain on-track maintenance equipment”.*
 3. Watchperson- *“The person stationed at the work area who is responsible for warning workers when a train is approaching”.*
 4. Qualified Protection Employee (QPE)- *“A SEPTA employee qualified on the operating rules, physical characteristics, and on track protection procedures and is responsible for establishing on-track protection and safety”. On-Track Safety rules No. 21 (OTS-21) states that the QPE must determine the method of providing protection to be used according to the operating rules.*

K. SEPTA's Hot Spot Rules:

SEPTA originally developed a "hot spot" reference manual for its track inspectors that designate certain track segments where a greater level of on-track protection is required due to; (1) line of sight issues, (2) difficult/non-existent egress, (3) noise and (4) clearance. The hot spot manual was compiled and vetted by the track inspections branch overtime. The manual specifically lists the hot spot locations and what additional on-track protection is required before entering that location. The locations are not identified or marked along the tracks to represent the dangers to other operating personnel and crafts.

At the time of the accident, the track department was the only craft utilizing the hot spot manual, but officials have since shared the manual with the rest of the engineering maintenance crafts and SEPTA's train control center for their use. The hot spot manual has now been implemented into SEPTA's roadway worker protection (RWP) program.

[END OF REPORT]