# Amtrak Passenger Train Head-on Collision With Stationary CSX Freight Train
# Cayce, South Carolina
# February 4, 2018


**Accident Report**

NTSB/RAR-19/02
PB2019-101308

National
Transportation
Safety Board

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Notation 59351
Adopted July 23, 2019

# Railroad Accident Report

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National Transportation Safety Board

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

**National Transportation Safety Board. 2019. Amtrak Passenger Train Head-on Collision With Stationary CSX Freight Train, Cayce, South Carolina, February 4, 2018. NTSB/RAR-19/02, Washington, DC.**

**Abstract:** On February 4, 2018, about 2:27 a.m., southbound Amtrak (National Railroad Passenger Corporation) train P91, operating on a track warrant, was diverted from the main track through a reversed hand-throw switch into a track and collided head-on with a stationary CSX Transportation (CSX) local freight train F777. The accident occurred on CSX's Florence Division, Columbia Subdivision in Cayce, South Carolina. The engineer and conductor of the Amtrak train died because of the collision. Ninety-one passengers and crew members on the Amtrak train were transported to medical facilities. The engineer of the stopped CSX train had exited the lead locomotive before the Amtrak train entered the track, ran to safety, and was not injured. The conductor on the CSX lead locomotive saw the Amtrak train approaching on the track and ran to the back of locomotive. The conductor was thrown off the locomotive and sustained minor injuries. Damage was estimated at $25.4 million. The investigation focused on the following safety issues: the medical examination process for railroad employees, the actions and responsibilities of the train crew handling the switches, operations during signal suspensions, a CSX efficiency testing program, implementation of a safety management system by Amtrak, and occupant protection in passenger railcars. As a result of the investigation, the National Transportation Safety Board makes two safety recommendations to CSX and one safety recommendation to all host railroads. The National Transportation Safety Board also reiterates four recommendations to the Federal Railroad Administration and one recommendation to Amtrak.

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# Abbreviations and Acronyms

| | |
|---|---|
| **Amtrak** | National Railroad Passenger Corporation |
| **AAR** | Association of American Railroads |
| **ABS** | Automatic Block System |
| **ACS** | Amtrak City Sprinter |
| **BLET** | Brotherhood of Locomotive Engineers and Trainmen |
| **BRS** | Brotherhood of Railroad Signalmen |
| **CAD** | Computer Aided Dispatch |
| **CCB** | Computer Controlled Brake |
| **CEO** | chief executive officer |
| ***CFR*** | *Code of Federal Regulations* |
| **COO** | chief operating officer |
| **CP** | control point |
| **CSX** | CSX Transportation Corporation |
| **DME** | Dakota, Minnesota & Eastern Railroad |
| **EC-1** | East Coast 1 |
| **EO** | emergency order |
| **FAA** | Federal Aviation Administration |
| **FRA** | Federal Railroad Administration |
| **GE** | General Electric |
| **HSLA** | high strength, low alloy |
| **I-ETMS** | Interoperable Electronic Train Management System |
| **KCAE** | Cayce Airport |
| **LAHT** | low-alloy, high-tensile |

| | |
|---|---|
| **LC** | Lexington County |
| **LDVR** | locomotive digital video recorder |
| **LED** | light-emitting diode |
| **MHz** | megahertz |
| **MOW** | maintenance-of-way |
| **MP** | milepost |
| **NIOSH** | National Institute for Occupational Safety and Health |
| **NORAC** | Northeast Operating Rules Advisory Committee |
| **NTSB** | National Transportation Safety Board |
| **NW** | Northwestern Airlines |
| **NYAB** | New York Air Brake |
| **POC** | point of collision |
| **PSAP** | Public Safety Answering Points |
| **psig** | pounds per square inch, gauge |
| **PTC** | positive train control |
| **PTS** | positive train stop |
| **RFE** | road foreman of engines |
| **RSAC** | Railroad Safety Advisory Committee |
| **RWP** | roadway worker protection |
| **SA** | Safety Advisory |
| **SAS** | southward absolute signal |
| **SPAF** | Switch Position Awareness Form |
| **SMS** | safety management system |
| **SS** | signal suspension |
| **SSPP** | system safety program plan |

| | |
|---|---|
| **SSWG** | system safety working group |
| **TC** | traffic control |
| **TCS** | traffic control system |
| **TSS** | Track Safety Standards |
| **TWC** | Track Warrant Control |
| **TWC-D** | Track Warrant Control—Non-Signaled |
| **UP** | Union Pacific Railroad |
| **US&S** | Union Switch and Signal |
| **VA** | Veterans Administration |

# Executive Summary

On February 4, 2018, about 2:27 a.m. local time, southbound Amtrak (National Railroad Passenger Corporation) train P91, operating on a track warrant, was diverted from the main track through a reversed hand-throw switch into a track and collided head-on with a stationary CSX Transportation Corporation (CSX) local freight train F777. The accident occurred on CSX's Florence Division, Columbia Subdivision in Cayce, South Carolina.

The engineer and conductor of the Amtrak train died because of the collision. Ninety-one passengers and crewmembers on the Amtrak train were transported to medical facilities. The engineer of the stopped CSX train had exited the lead locomotive before the Amtrak train entered the track. When he saw that it was entering the track, he ran to safety and was not injured. The conductor on the CSX lead locomotive saw the Amtrak train approaching on the track and ran to the back of the locomotive. The conductor was thrown off the locomotive and sustained minor injuries. Damage was estimated at $25.4 million.

The normal method of operation on this segment of track was by wayside signal indications of a traffic control system. On the day prior to the accident, CSX signal personnel began upgrading signal system components to implement positive train control on the subdivision. Signal personnel ceased work for the day at 7:00 p.m., prior to completing planned work. The signal suspension remained in place resulting in the continued use of track warrants to move trains through the affected area of signal suspension.

At the time of the accident, it was dark, and the sky was cloudy. The temperature was 40°F, and there was light wind from the east.

Parties to the investigation include the Federal Railroad Administration; CSX Transportation Corporation; Amtrak; Brotherhood of Locomotive Engineers and Trainmen; International Association of Sheet Metal, Air, Rail, and Transportation Workers; Brotherhood of Railroad Signalmen; and the State of South Carolina Office of Regulatory Staff.

As a result of the initial findings of this investigation on February 15, 2018, the National Transportation Safety Board issued Safety Recommendation R-18-5 to the Federal Railroad Administration (FRA). This urgent recommendation asked the FRA to issue an emergency order providing instructions for railroads to follow when signal suspensions are in effect, and a switch has been reported relined for a main track.

The FRA chose not to issue an Emergency Order, instead proposing a Safety Advisory. On November 20, 2018, the FRA published the Safety Advisory.

The accident investigation focused on the following safety issues:

- The medical examination process for railroad employees.
- The actions and responsibilities of the train crew handling switches.
- CSX Transportation efficiency testing program and staffing.

- Operations during signal suspensions.
- Implementation of a safety management system by Amtrak to assess and mitigate risks for operation on host railroads.
- Occupant protection in passenger railcars.

The National Transportation Safety Board determines the probable cause of this collision of trains was the failure of the CSX Transportation Corporation to assess and mitigate the risk associated with operating through a signal suspension, which eliminated system redundancy for detecting a switch in the wrong position. The CSX Transportation Corporation conductor failed to properly reposition the switch for the main track, which allowed National Railroad Passenger Corporation (Amtrak) train P91 to be routed onto the Silica Storage track where the standing CSX train F777 was located. Contributing to the accident was the Federal Railroad Administration's failure to implement effective regulation to mitigate the risk of misaligned switch accidents. Also contributing to the accident was National Railroad Passenger Corporation's (Amtrak) failure to conduct a risk assessment prior to operating during a signal suspension.

# 1 Factual Information

## 1.1 Accident Synopsis

On February 4, 2018, at 2:27 a.m. local time, southbound Amtrak (National Railroad Passenger Corporation) train P91 (P91), operating on a track warrant, diverted from the main track through a reversed hand-throw switch into a track and collided head-on with stationary CSX Transportation Corporation (CSX) local freight train F777.[1] The accident occurred on the CSX Florence Division, Columbia Subdivision in Cayce, South Carolina. At the time of the accident, it was dark, and the sky was cloudy. The temperature was 40°F, and there was light wind from the east.


**Figure 1.** A view of the accident scene looking north.

The engineer and conductor of the Amtrak train died as a result of the collision. Ninety-one passengers and crewmembers on the Amtrak train were transported to medical facilities. The engineer of the stopped CSX train had exited the lead locomotive before the Amtrak train entered the track. When he saw that it was entering the track, he ran to safety and was not injured. The conductor of the CSX lead locomotive saw the Amtrak train approaching on the track and ran to

[1] All times in this document are local time unless otherwise denoted.

the back of the locomotive. The conductor was thrown off the locomotive and sustained minor injuries. Accident damage was estimated at $25.4 million.

Parties to the investigation include the Federal Railroad Administration (FRA); CSX; Amtrak; Brotherhood of Locomotive Engineers and Trainmen (BLET); International Association of Sheet Metal, Air, Rail, and Transportation Workers; Brotherhood of Railroad Signalmen (BRS); and the State of South Carolina Office of Regulatory Staff.

## 1.2 Events Prior to the Accident

### 1.2.1 Operations During the Signal Suspension

On the day before the accident, February 3, 2018, at 7:23 a.m., CSX signal personnel suspended the traffic control signal system to install upgraded traffic control system components in preparation for implementing positive train control (PTC) on the subdivision. During the suspension, scheduled to last through February 4, 2018, or until the signal suspension work was completed and the Signal Department notified them that they were done, the dispatchers used track warrants to authorize trains through absolute blocks in the work territory.[2] As shown in the figure 4 map of the Amtrak signal suspension route and the figure 2 signal suspension limits diagram, the signal suspension affected train movements between milepost (MP) S 362.5 to MP S 385. The signal personnel stopped work at 7:00 p.m. due to the FRA hours-of-service requirements and were scheduled to return on February 4 to complete the work. The signal suspension remained in effect.

[2] (a) A *track warrant* is authorization to use a controlled track. It is received in writing or copied on the prescribed forms and repeated at the direction of the train dispatcher or control station using radio or other communication. (b) CSX used a mandatory directive, known as an *East Coast 1* (EC-1) *form*, which is used in Track Warrant Control-Non-Signaled (TWC-D) territory, permitting passenger trains to proceed at speeds not to exceed 59 mph and for freight trains to proceed at speeds not to exceed 49 mph. The EC-1 form is used to record specific instructions or dispatcher messages regarding movement on controlled tracks. (c) *Track Warrant Control—Non-Signaled* (TWC-D) specifically refers to when the authority for movement on a controlled track is designated in special instructions, dispatcher message, or Form EC-1. TWC-D, trains will be governed by verbal authority from the train dispatcher. (d) *Absolute block* means a block in which no train is permitted to enter while it is occupied by another train. (e) CSX's chief engineer of signals and communication explained in an interview that, although they thought the work could be completed in 1 day, they nonetheless asked for 2 days in case they ran into problems or delays.

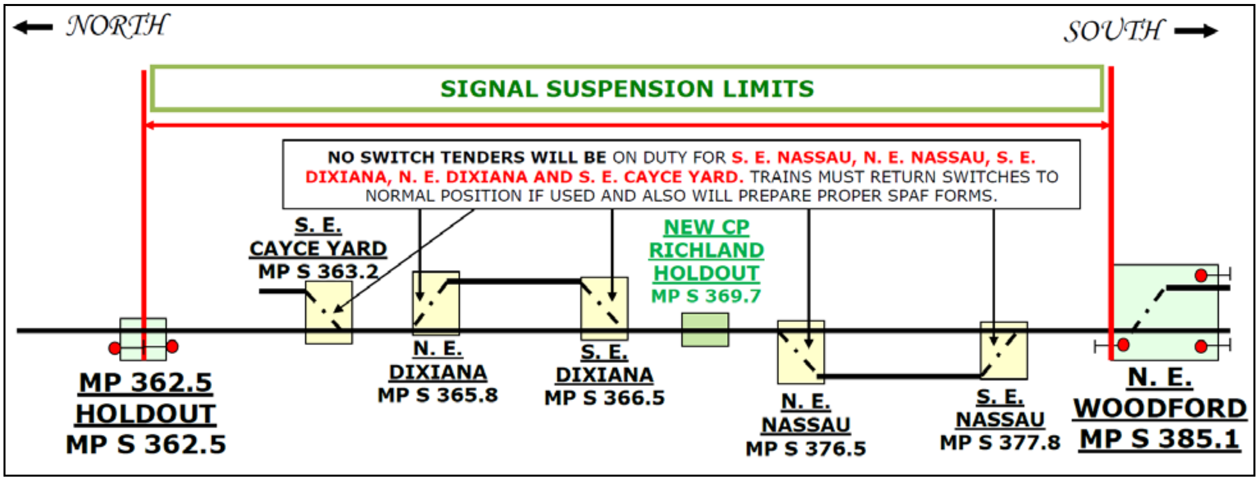


**Figure 2.** Signal suspension limits diagram labeled (provided by CSX).

The signal suspension instructions further defined that the southward absolute signal (SAS) at MP S 362.5 Holdout would govern movement into the limits of the signal suspension and that southbound trains must have both permission to proceed and an EC-1 track warrant authority from the FF (desk designation letters for the dispatcher) train dispatcher at Jacksonville before passing the SAS at MP S 362.5.

The accident occurred on a track referred to as Silica Storage, which extended between MP S 366.9 and MP S 367.9 on the west side of the main track. (See figure 5 diagram of the Silica Storage track area.) Before the accident, the CSX crew was working in an automobile unloading lot to the east of the main track, eventually putting together a consist of 34 empty auto racks and placing it on the Silica Storage track. The automobile unloading lot was accessed through another track called the runaround track, which extended from MP S 367.0 and MP S 367.4. The CSX crew used the main track, the runaround track, and the Silica Storage track to assemble the consist. The crew placed the completed train on the Silica Storage track just before 1:51 a.m. on February 4, 2018. (See figure 7 in this report for a diagram of the area.)

There is a single main track through this area, and two Amtrak trains pass through daily—one southbound Amtrak train P91 and one northbound Amtrak train P92. In normal operations, the dispatchers can only see the placement of the control point switches on the track, including the switches for the Silica Storage track and the automobile lot runaround track.[3] The placement of the switches would have been reported by a signal indication. Because of the signal suspension, the disposition of the switches in the affected area was assumed to be unavailable to dispatchers, and operations were conducted using track warrants issued by radio. The crew had to hand operate the switches any time those types of switching moves were made at the auto ramp, and they would have to use the Switch Position Awareness Form (SPAF) only during a signal suspension.[4] During

[3] A *switch* is a device consisting of necessary rails and connections designed to change the direction of a movement from the track on which it is moving to another track.

[4] A *Switch Position Awareness Form* (SPAF) is a form completed and signed by the train engineer or conductor in signaled territory when signals are not functioning. The SPAF is a log of the location of the switch being operated, the time the switch was initially reversed, the time it was restored and locked in the normal position, and the name of the employee who operated the switch. See appendix C for an example of a SPAF.

a signal suspension, the dispatcher could see a track occupancy light on his board, and he did say that he saw or observed one the night of the incident; however, because it was during a signal suspension, he also said he was instructed to disregard the signal.

### 1.2.2 Amtrak Train P91

Amtrak train P91, the Silver Star, originated in New York City and was destined for Miami, Florida. The P91 electric locomotive was changed to a diesel locomotive in Washington, DC, where the electrified catenary system ends.[5] Behind the locomotive, the train contained seven cars: three passenger coaches, a lounge coach, two sleeper coaches, and a baggage coach. Upon departure from Washington, DC, Amtrak train P91 made scheduled station stops at Alexandria, Virginia; Richmond, Virginia; Petersburg, Virginia; Rocky Mount, North Carolina; Raleigh, North Carolina; Cary, North Carolina; Southern Pines, North Carolina; Hamlet, North Carolina; Camden, South Carolina; and Columbia, South Carolina, with no reported problems by the train crew with the consist or brake system. Figure 3 shows the Amtrak Silver Star route from New York City to Miami and the collision location in Cayce.

[5] On railroads with electrically powered trains, *catenary* describes the overhead conductor, which is contacted by the pantograph or trolley, and its support structure that supplies electricity to propel trains. A *catenary pole* is a single pole used to support the catenary wire, and a *catenary bridge* is made up of two poles with a truss that spans across the railroad tracks to support several catenary wires.


**Figure 3.** Amtrak Silver Star route from New York to Miami showing collision location.

There was a crew change at Hamlet, North Carolina for Amtrak train P91. The new crew was scheduled to operate the train from Hamlet, North Carolina, to Jacksonville, Florida. The crew of Amtrak train P91 included a locomotive engineer, a conductor, an assistant conductor, and five service employees. They went on duty at 10:43p.m., February 3, 2018.

Once on duty at Hamlet, the train crew conducted a job briefing. The assistant conductor told investigators they reviewed the train orders and bulletins pertaining to their train movement. An Amtrak road foreman of engines (RFE) job briefed the train crew about the signal suspension that was in effect between MPs S 362.5 and S 385.1 near Cayce, South Carolina. The RFE explained that the crew would be required to get an EC-1 authority to enter the limits of the signal suspension and that the SPAF would have to be filled out if any main track switches were to be handled.

CSX Columbia Subdivision Bulletin 105 was issued to both the Amtrak and the CSX local train crews explaining the process to operate their trains through the signal suspension under operating speed restriction. According to Title 49 *Code of Federal Regulations* (*CFR*) 236.0, trains operating in territory that is not equipped with a signal system must not exceed 59 mph for passenger trains and 49 mph for all other trains.[6]

The trip from Hamlet to Columbia, South Carolina, was uneventful according to the assistant conductor. Prior to entering the signal suspension limits, southbound Amtrak train P91 stopped to pick up and drop off passengers at the Columbia passenger station.[7]

Upon arriving at Columbia, the crew assisted passengers and waited to leave at the scheduled time. While at the Columbia Station, the conductor contacted the dispatcher to request an EC-1 for the signal suspension limits that the train would need to traverse. At 2:01 a.m., while still at the Columbia Station, the train dispatcher issued an EC-1 to proceed through the signal suspension limits, and the train continued southbound. Figure 4 shows the limit of the signal suspension between Cayce Yard and NE Woodford.

Amtrak train P91 departed Columbia, South Carolina, with 141 passengers, 110 ticketed for coach seating and 31 ticketed for roomettes or bedrooms, and 8 crewmembers. The engineer and conductor were in the locomotive; the assistant conductor was in the lounge car, and other service attendants were either in roomettes or sitting in other cars. Investigators do not know the exact location of the five service personnel.

[6] Title 49 *Code of Federal Regulations* (*CFR*) 236.0, "Applicability, Minimum Requirements and Penalties": … (c)(2) "On and after January 17, 2012, where a passenger train is permitted to operate at a speed of 60 or more miles per hour, or a freight train is permitted to operate at a speed of 50 or more miles per hour, a block signal system complying with the provisions of this part shall be installed, unless an FRA approved PTC system meeting the requirements of this part for the subject speed and other operating conditions is installed."

[7] The railroad timetable direction of the train was south. Timetable directions are used throughout this report.

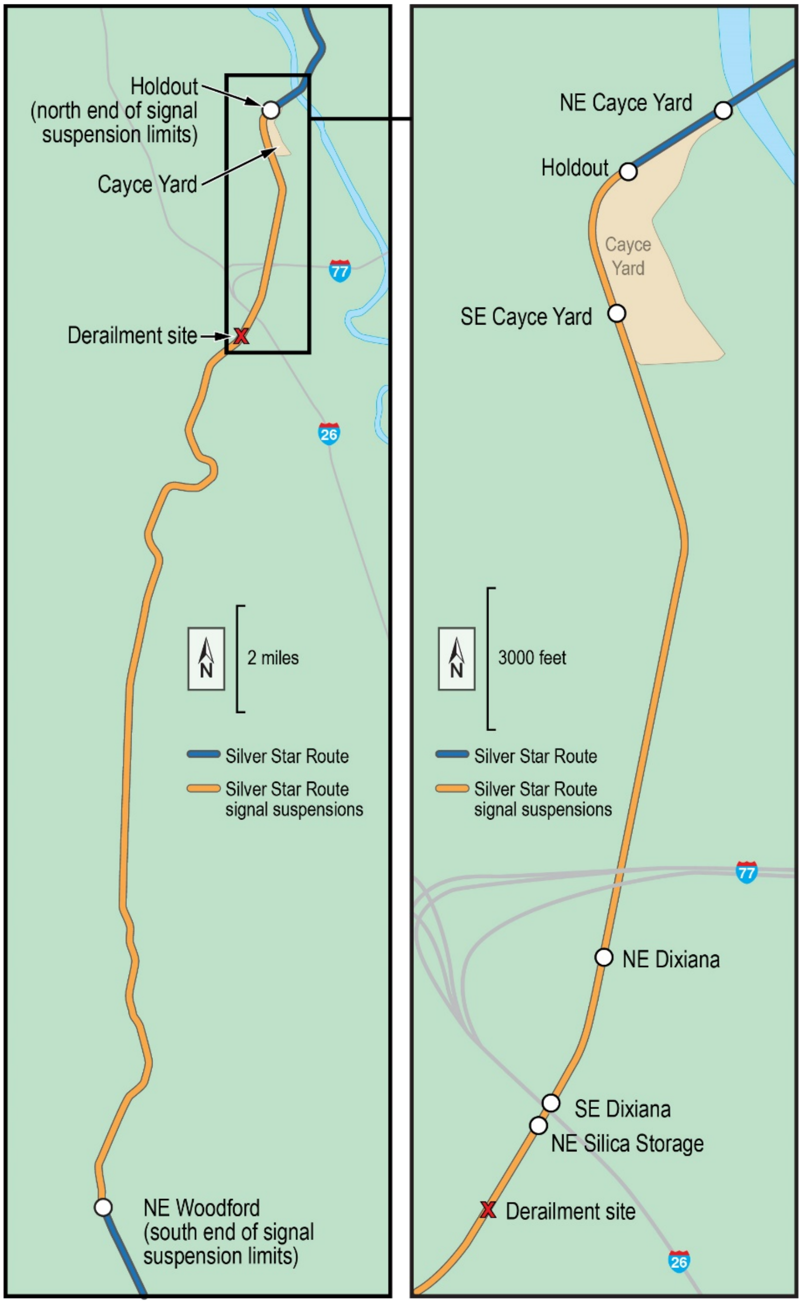


**Figure 4.** The Amtrak signal suspension route.

Prior to departing Columbia, the Amtrak train P91 conductor told the assistant conductor that he would be riding on the head end (lead locomotive) with the engineer to talk him through the suspension. Amtrak train P91 departed Columbia at 2:04 a.m. and stopped at the red signal at MP S 362.5 at 2:09 a.m., according to event recorder data, to get permission to pass the stop indication to enter the limits of the signal suspension. The conductor of Amtrak train P91 contacted the CSX train dispatcher to obtain permission to proceed past the red signal and to enter the limits of the signal suspension located between MP S 362.5 and MP S 385.1. Amtrak train P91 waited about 10 minutes before the train dispatcher answered the radio and gave them permission to pass by the red signal, and the train started movement at 2:21 a.m., according to event recorder data.

### 1.2.3 CSX Train F777

The CSX train crew went on duty at 3:00 p.m. on February 3, 2018, at CSX Cayce Yard. Each of the crewmembers received more than the required minimum off-duty period of rest prior to reporting for duty.[8] About 3:30 p.m., the trainmaster on duty had a job briefing via telephone with the train crew on the signal suspension that was in effect between MP S 362.5 and MP S 385.1.[9] The trainmaster explained to the train crew that they would be operating under EC-1 track warrant control–non-signaled (TWC-D) and that the SPAF would be required. (See footnote 4.) The train crew of F777 received an EC-1 at 8:10 p.m. on February 3, 2018, to proceed south from MP S 362.5 Holdout on the main track to MP S 367.4 SAS Richland Holdout on the main track. The EC-1 authority also included permission to use the two switches providing access to the Silica Storage track located at MP S 366.9 and MP S 367.9 and to use the switch at the north end of the runaround track providing access to the automobile loading lot at MP S 367.0. (See figure 5.) The switches within the limits of the signal suspension were to be operated in accordance with Operating Rules 401 and 505.12 under the directions of the FF (name of the desk) train dispatcher at Jacksonville.[10] Before working at the Silica Storage track, the crew was instructed by the yardmaster to relieve the crew of the CSX 794 train that had expired on the single main track under the hours-of-service regulation.

At 8:31 p.m., the F777 crew reported to the CSX dispatcher that their train was south of North Dixiana at MP S 365.8. At 8:32 p.m. the train dispatcher issued the train crew a new EC-1 to operate from the north end of Dixiana to Richland and that they could “change direction only.”[11] When the train crew on F777 arrived at the Silica Storage track, they continued to move forward on the main track with 38 loads and 2 locomotives. The crew then secured the train, uncoupled the locomotives, and left the loads on the main track between the Silica Storage track switches. The conductor operated the track switch at the south end of the Silica Storage track, and the crew traveled northbound with the two locomotives via the Silica Storage track.

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[8] The CSX engineers received 16 hours, 8 minutes rest; the conductor received 16 hours, 7 minutes rest.

[9] A trainmaster is a supervisor/manager of transportation employees such as conductors, switchmen, engineers, and others who either work in rail yards or operate trains.

[10] CSX Operating Rule 401 is Operating Switches and Derails by Hand; Rule 50512 is Track Warrant Control Non-Signaled (TWC-D) location.

[11] Change directions meant that CSX train 777-03 was authorized to move in both directions, south and north, within the limits of its track warrant.

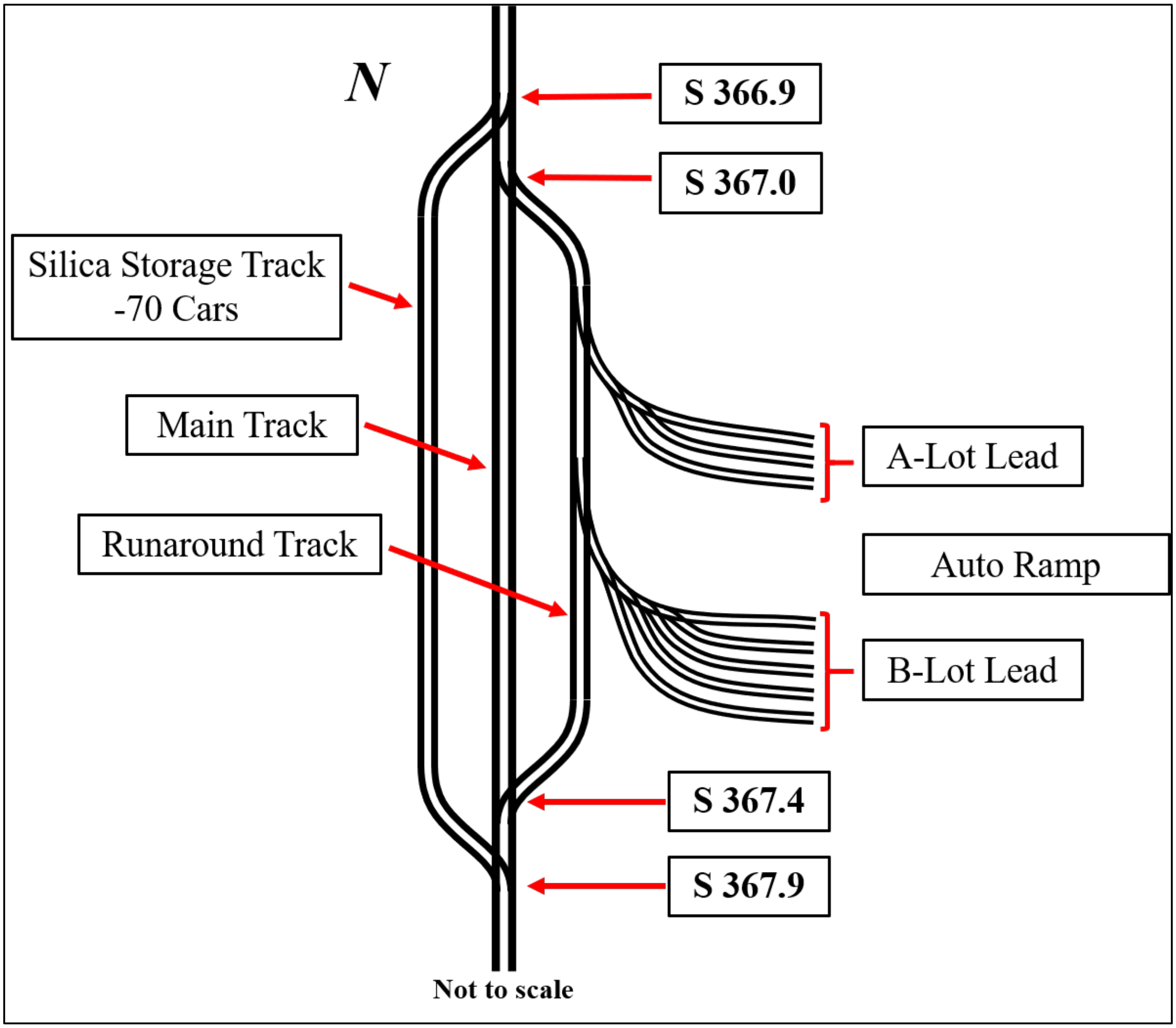


**Figure 5.** Diagram of Lots A and B and tracks at Silica Storage track. (Milepost locations of the switches found on page 7 of CSX Columbia Timetable No. 1.)

After the train crew reached the north end of the Silica Storage track, the conductor operated the switch and lined it to the main track. The crew entered the main track after clearing the switch and traveled south to the main track switch that leads to the runaround track. The conductor operated the north switch, and the train entered the runaround track to access automobile loading Lots A and B. The train crew put together the empty cars from Lots A and B and returned to the main track to place the 30 empty cars into the Silica Storage track via the north Silica Storage track switch.

F777 returned to the runaround track and picked up four empty auto racks that had been left behind earlier. They returned to the Silica Storage track and coupled them to the other 30 cars.

F777 left the Silica Storage track with light locomotives and picked up the loaded auto rack cars from the main track and placed them into multiple tracks of Lots A and B.[12]

F777 traveled northbound out of the Lot A with light locomotives past the Silica Storage track switch, and the conductor operated the switch from the main track to the Silica Storage track. As the locomotives traveled southbound into the track, the conductor instructed the engineer by radio to stop the locomotives just past the derail.[13] The engineer said that when he stopped the locomotives just past the derail, "I noticed he was already there; that is the reason I asked him did he get the switch." The engineer explained he saw the conductor line the Silica Storage track derail for derailing position, walk east toward the main track switch that led to the runaround track, and line it for normal movement (main track). The conductor then lined the derail on the runaround track for the derailing position; however, the north end of Silica Storage track had not been lined and locked back for main track movement. The conductor returned to the Silica Storage track. The crew proceeded south and coupled the locomotives against the standing auto racks that had been placed earlier in the track.

Both the engineer and conductor said that each filled out a SPAF while the switches were operated in the vicinity of Silica Storage track. After the conductor accepted the release time of 1:51 a.m., the train dispatcher asked, "and everything is in the clear is that right, over?"[14] The conductor replied by saying "That's right and we locked up in Silica."[15]

The engineer and conductor sat in the cab of the locomotive waiting for a ride home. In the interview, the engineer estimated that they had been waiting for about 10 to 20 minutes when he asked the conductor if he realigned the Silica Storage track main track switch. In the conductor's interview, he said that he replied that he was sure he got it. The statements of both the engineer and the conductor agreed with each other. The conductor then requested the engineer turn on the locomotive headlights to verify the position of the Silica Storage track switch, but the light did not reach the area around the switch, which was dark.

## 1.3 The Accident

### 1.3.1 Amtrak Train P91

Investigators reviewed the event recorder and video data from Amtrak locomotive 47 and synchronized the data to the clock systems used by the signal department and dispatcher center. The data indicates that Amtrak train P91 departed the Columbia station at 2:03:42 a.m. The train came to a stop at 2:09:17 a.m. at MP 362.42, short of a red signal at Holdout), to enter into the signal suspension limits. The dispatcher granted authority to pass the red signal. The assistant

[12] A *light locomotive* is a locomotive consist without cars attached to it.

[13] A *derail* is a device that sits on top of a rail and is designed to divert the wheels of a piece of equipment away from the main track or to the field side of the track it is on, thus keeping the equipment from entering another track, usually a main track.

[14] *Track is clear* means the portion of the track to be used for the intended movement is unoccupied by rolling equipment, on-track maintenance-of-way equipment, and conflicting on-track movements; intervening switches and fixed derails are properly lined for the intended movement.

[15] Refer to Appendix E, Title 49 CFR 218.105 at the end of the report for additional operational requirements for hand-operated main track switches.

conductor said that once they had copied the EC-1 and received authority to pass the signal at MP S 362.5, they began operating south again. According to the event recorder, the movement south began at 2:21:17 a.m.

According to the assistant conductor's interview, as the southbound train approached the accident area, the locomotive engineer and conductor were on the lead locomotive; the assistant conductor was seated in the lounge car.

According to the locomotive event recorder, the train began movement again at 2:21:17 a.m. The train reached a maximum speed of 57 mph around MP S 366.5. At 2:27:21 a.m., the train's horn sounded. At this time, the train's speed was 56 mph. At 2:27:24 a.m., the throttle changed from throttle position 8 (T8) to idle. At 2:27:25 a.m., the train entered emergency braking via an "engineer-induced emergency." The train's speed was 53 mph. Due to the collision, the data ended at 2:27:27 a.m. Figure 6 shows the accident site, the path of the train from the entry point into the track from the north, and the approximate point of collision 660 feet south of there and just west of a four-lane highway.

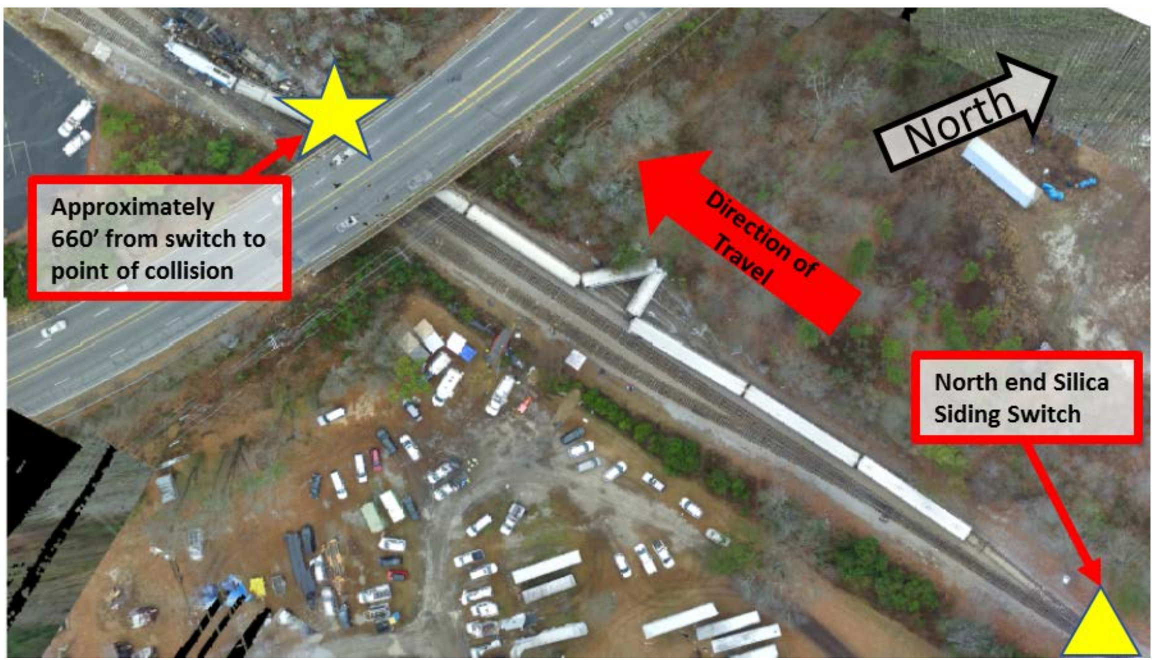


**Figure 6.** Aerial drone image of accident location. (Photo courtesy of South Carolina Department of Public Safety.)

Immediately prior to the collision, the assistant conductor of Amtrak train P91 was preparing to contact the engineer and conductor to remind them of a defect detector.[16] He said the next thing he remembered was that he was sitting at the rear seat of the lounge car and that the train began to lurch and that he was being thrown around. He said that when they struck, "the café

[16] A *defect detector* is a wayside device railroads use to scan passing trains for defects like hot bearings; dragging equipment; and high, wide, or shifted loads.

car started closing in on itself, got knocked onto the floor." The assistant conductor called out "91 AC to head end" and said that he did not get a response.

The assistant conductor called out "emergency" over the radio and was able to establish communication with the CSX train dispatcher. The assistant conductor explained to the train dispatcher what had just occurred and that the rear of the train was at MP S 367 and that there was a CSX locomotive on the adjacent track. The train dispatcher responded by saying, "I know where you are."

The assistant conductor walked toward the head end of the train and saw that the locomotive was lying on its side and that diesel fuel was leaking from the locomotive. He recognized that the two train crewmembers who had been on the locomotive were deceased. He returned to the passenger cars and started to evacuate the passengers. The assistant conductor, along with the local police, searched the cars to ensure that all passengers had been evacuated.

### 1.3.2 CSX Local F777

The F777 freight train switched auto racks at the auto ramp for about 3 hours. In his interview, the conductor stated that he was aware of the Amtrak train schedule and the need to be in the clear. After finishing their switching in the auto ramp, the conductor had the engineer operate the two light locomotives back onto the main track north of the Silica Storage track switch. The conductor had operated the north switch of the Silica Storage track several times before they began making a reverse movement south, backing into the Silica Storage track.

According to the forward-facing video from locomotive CSX130, at 1:40:04 a.m., the train moved forward out of the auto ramp facility onto the runaround track, headed toward the main track. The area near the auto ramp facility and the mainline track appeared to be lit by flood lights. The area of the north Silica Storage track switch was not lit.

For most of the video recording, the conductor was not visible in the view of the forward-facing camera of CSX130. At 1:42:04 a.m., the locomotives exited the auto ramp area and entered the main track, the locomotives stopped on the main runaround track switch. At 1:42:44 a.m., the locomotives began moving forward on the main track and went past the north end switch into the Silica Storage track. At 1:43:37 a.m., the train began a reverse movement on the Silica Storage track.

The video shows that at 1:44:06, as the train made a continuous reverse movement across the north end of the Silica Storage track switch, the conductor was not seen in the video at the switch point area after F777 passed over the switch.

Figure 7 shows the north switch area for the Silica Storage track where train F777 made its last move into that track. The derail is located 215 feet from the switch, and the track is west of the main track. The crew was moving two locomotives into the track. The point of collision and overhead highway bridge are shown about 660 feet from the switch.

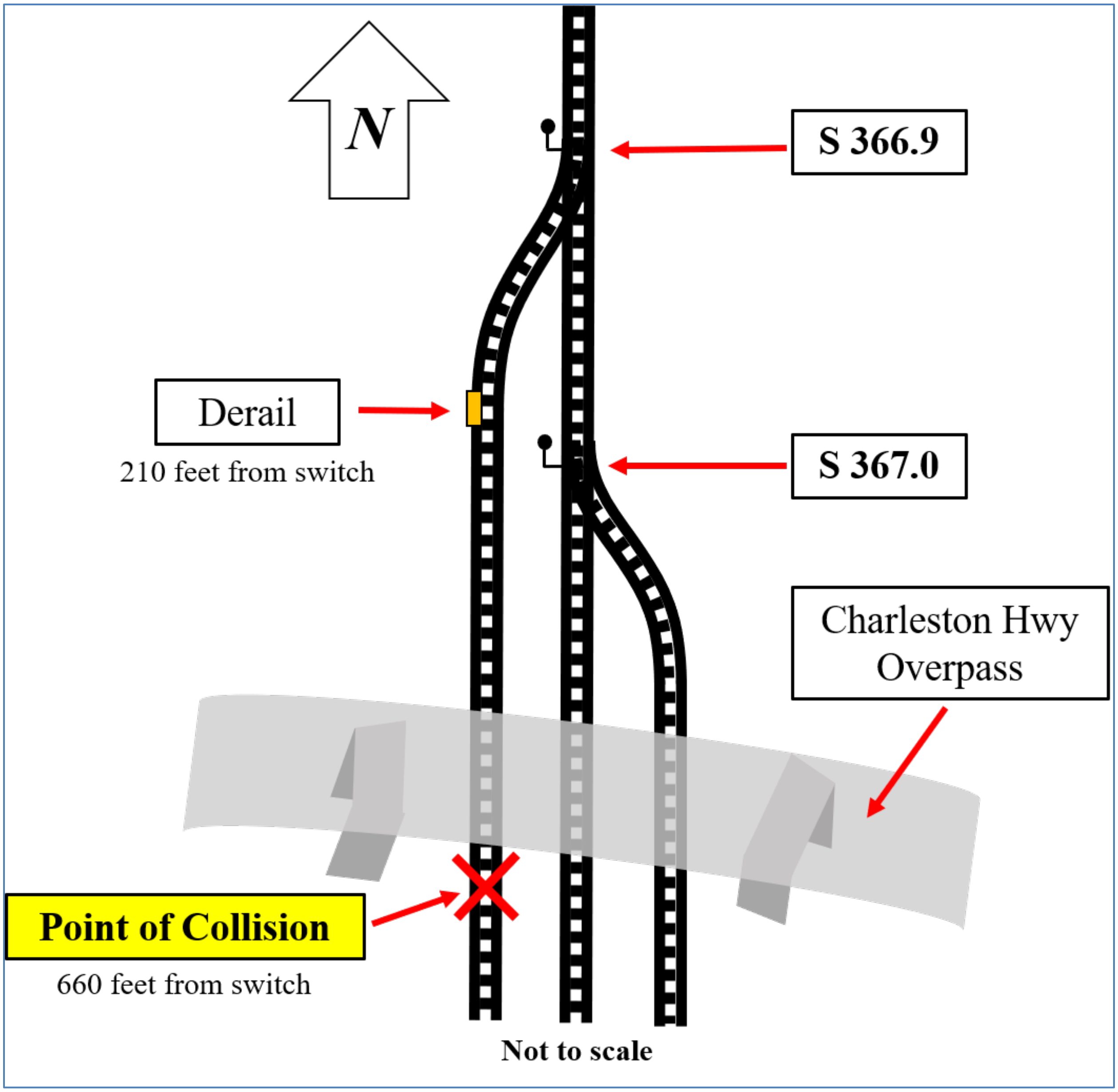


**Figure 7.** Close-up view of final move of F777 into Silica Storage track.

At 1:44:24 a.m., the locomotive came to a stop south of the derail for the Silica Storage track. At almost the same time, the conductor in a safety vest was visible in front of the locomotive. The conductor was bending at the waist, then became upright and walked across the Silica Storage track and the main track.

The conductor was not within the view of the forward-facing camera by 1:44:32 a.m.; however, the main track switch into the north end of the runaround track into the auto ramp facility can be seen lined for the main track at 1:44:44 a.m.

At 1:45:28 a.m., some voice or radio chatter was detected. The word “clear” was detected. At 1:45:35 a.m., as the locomotive began a reverse movement, the derail became visible in the "on" position. According to event recorder data, the locomotive continued the reverse movement until 1:46:31 a.m. when it came to a stop.

In his interview, the conductor stated that after coupling the locomotives to the cars on the storage track, he returned to the lead locomotive (CSX 130). When the conductor entered the locomotive, the engineer handed the conductor the SPAF and asked the conductor if he lined the main track switch back to normal position. The conductor answered "yes" and instructed the engineer to press key 3 on the radio keypad to tone (call) the train dispatcher to establish communications. The CSX train dispatcher answered, and the conductor communicated the release of the switches, which is noted in the transcript of the radio communication with the CSX dispatcher below.

> **Conductor:** Alright I got a switch time for you on that 366.9, uhh 2012 uhh before that 2015 or 20 sorry 2015. 366, or 367.9 reversed 2048 restored 2049, 367.0, reversed 2132, restored 2210.
>
> **Dispatcher:** I assumed the time recorded on three switches _____ switch position ____. (Dispatcher initials) over.
>
> **Conductor:** Sorry about that EC-1 #93537 F77703, Engine CSX 36, ____North end of Dixiana and SAS Richland Holdout over.
>
> **Dispatcher:** EC-1 #935737 F77703, with the CSX 36, (name of conductor) being released on authority of all tracks. It's going to be between SAS Signal North end of Dixiana and the SAS Signal Richland holdout. So that release time is now 0151. (Dispatcher initials) over.
>
> **Conductor:** Alright 0151 over.

After the conductor accepted the release time at 1:51 a.m., the train dispatcher asked, "and everything is in the clear is that right? Over." The conductor replied by saying "That's right and we locked up in Silica." At 1:51:34 a.m., the locomotive's headlight became extinguished.

There was no target on the switch for the engineer and conductor to see which way it was lined.[17] According to event recorder data, at 2:25:50 a.m., about 1 minute prior to the collision, the locomotive's headlight was turned to a bright setting. A view forward of the locomotive was captured by the image recorder, but the position of the Silica Storage track switch could not be ascertained. Five seconds later, the locomotive's headlight was extinguished. In their interviews, the F777 crewmembers stated that they were not able to see the switch position clearly.

The engineer decided to walk to the switch to ensure it was correctly aligned. The engineer told the conductor that he wanted to check the switch and "stretch his legs." He said that he just "had a feeling," and wanted to go check it. He told investigators that he left the locomotive and descended to the main track. At 2:26:29 a.m., a locomotive headlight approaching in the opposite

[17] A *target* is a red/green visual indicator on a switch that makes it easier for crews to visually verify the position of the switch. As one approaches the switch, seeing red indicates the switch is reversed and green means the switch is lined normal for the main track.

direction became visible. A reflection on the CSX locomotive's front grab iron on the short hood and window was also visible around the same moment. A moment later, a reflection flashed again. At 2:26:32 a.m., a light like that of a handheld light was visible illuminating a small spot on the west rail of the main track. As captured on the head end video recorder, the headlight from the oncoming train was visible growing larger and brighter in intensity.

At 2:26:42 a.m., a handheld light beam was visible reflecting off concrete pillars to the front left of the locomotive (west side of the locomotive). However, as the engineer descended from the locomotive to track level, he saw the Amtrak train coming, but he did not have enough time to get to the switch before the arrival of the train, so he decided to simply "watch it pass by." As the engineer saw the approaching Amtrak train take the diverging route into the Silica Storage track, he decided to run up the hill away from the impending collision. The engineer proceeded toward the highway above the tracks to see if he could flag someone down and ask for assistance.

The conductor said "they [Amtrak] just hit the side [entered the storage track] and came flying fast down right at us." Prior to the collision, the conductor ran out the back door of the locomotive. When the Amtrak train struck F777, the conductor was thrown from the CSX locomotive and then became pinned between the CSX and Amtrak locomotives. After a few moments, the conductor managed to free himself. The conductor said that he was doused in diesel fuel, and when the engineer returned to the accident scene, he said, "I can't believe you made it."

## 1.4 Incident Management

The accident occurred in Lexington County (LC) in South Carolina. The county is responsible for emergency response. The LC government uses a Public Safety Answering Points (PSAP) system to coordinate its county-wide emergency response. This management system is a high-level framework that officials can use to develop and customize community-level emergency response plans that consider local resources and practices.

Table 1 documents the injury severity by hospital. Of note, a single adult male with serious injuries was initially evaluated at the Veterans Administration (VA) hospital and transferred to the trauma center (Richland). He was counted in the Richland group. The uninjured or those who refused medical care were transferred to an assistance center. Figure 8 maps the locations of the five hospitals in Lexington County, with the number of patients from Amtrak train 91 that they treated.

**Table 1.** Amtrak train P91 injury severity by hospital.

| Hospital | Serious | Minor | None | Unknown | Total |
|---|---|---|---|---|---|
| **Palmetto Richland** | 4 | 29 | 0 | 9 | 42 |
| **Lexington Medical Center** | 3 | 19 | 3 | 0 | 25 |
| **Palmetto Baptist** | 1 | 4 | 0 | 1 | 6 |
| **Palmetto Baptist Parkridge** | 0 | 8 | 0 | 1 | 9 |
| **VA Medical Center** | 1[a] | 5 | 0 | 3 | 9 |

[a] One adult with serious injuries was originally evaluated at the VA Medical Center but then transferred to the Richland trauma center.

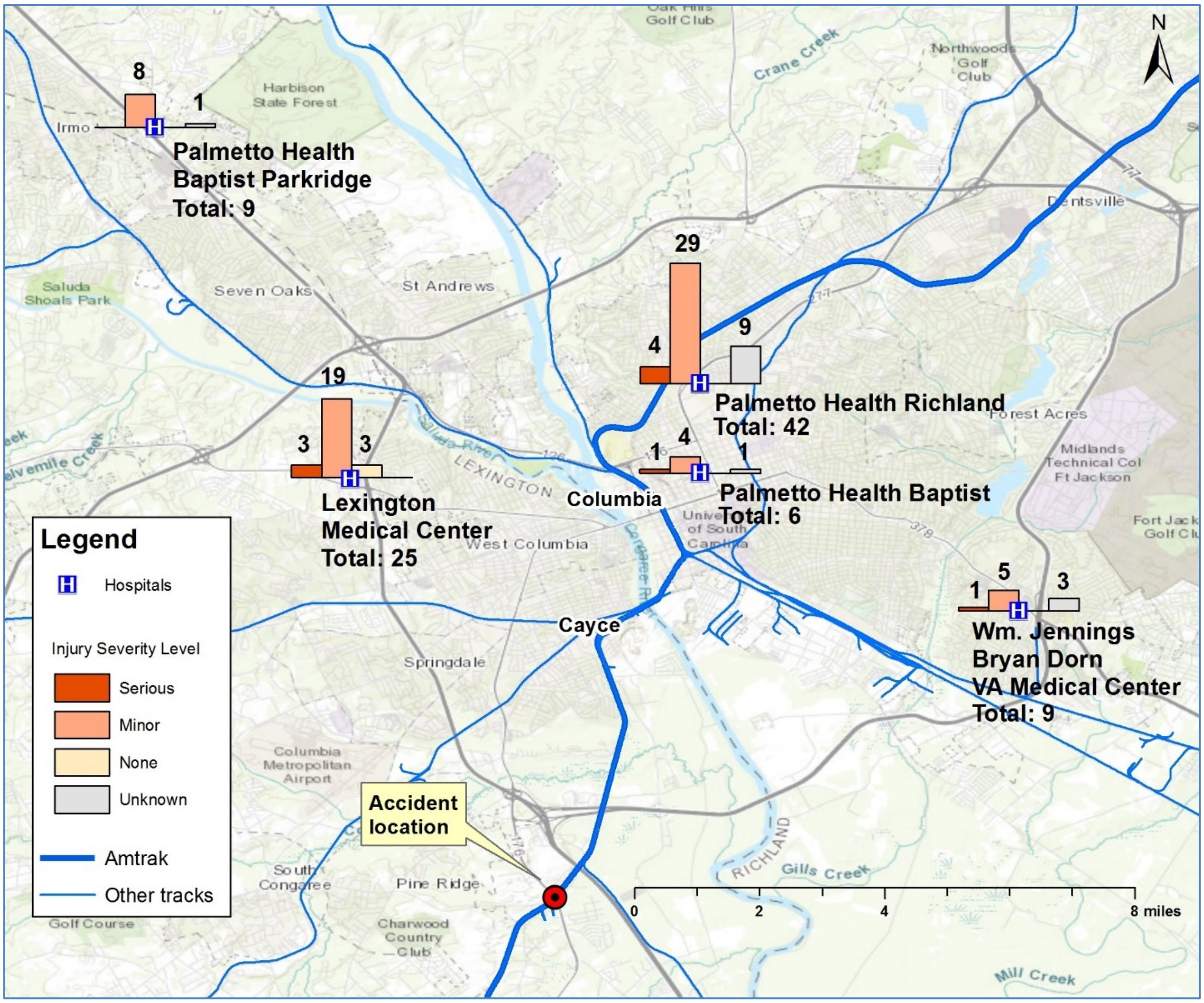


**Figure 8.** Hospitals by injury count from Amtrak train P91.

The first 911 call reporting the train derailment was placed by a local citizen and received at LC 911 at 2:33 a.m. At 2:34:30 a.m., LC Emergency Medical Services received its first call about the incident and dispatched the first unit 42 seconds later. That unit arrived on scene at 2:40 a.m. The LC Law Enforcement Computer Aided Dispatch (CAD) log documented that local police received their first call about the event at 2:34:46 a.m. The Cayce Police Department initially dispatched four units at 2:35:57 a.m., arriving within the first hour of the response;

15 additional law enforcement units were dispatched. The first police unit arrived on scene at 2:39 a.m.

At 2:38 a.m., Cayce PSAP received a call from Columbia dispatch.[18] The first LC fire department arrived on scene at 2:42 a.m. A unified command was established on scene at 3:03 a.m., and an Emergency Operations Center was activated at 3:05 a.m. A reception center was activated at 3:44 a.m. at Pine Ridge Middle School to receive uninjured passengers. The first patient transport unit left the scene at 4:01 a.m. The last patient transport unit left the scene at 5:49 a.m. The last passenger was transported to Pine Ridge Middle School and arrived at 6:00 a.m.

## 1.5 Injuries on Amtrak Train P91

The Amtrak engineer and conductor died in the collision; 92 people were transported to local hospitals. This included 91 people from Amtrak train P91 and the CSX conductor. Table 2 shows the injuries on Amtrak train P91 from the accident. This table is based on hospital records received by the National Transportation Safety Board (NTSB). There were 141 passengers and 8 crew on the Amtrak train; individuals who did not visit a hospital are not counted below.

**Table 2.** Amtrak train P91 occupant injuries.

| Injury Type[a] | Amtrak Crew Passenger cars | Amtrak Crew Locomotive | Passengers | Total |
|---|---|---|---|---|
| Fatal | 0 | 2 | 0 | 2 |
| Serious | 1 | 0 | 8 | 9 |
| Minor | 3 | 0 | 62 | 65 |
| None | 0 | 0 | 3 | 3 |
| Unknown | 0 | 0 | 14 | 14 |
| Total | 4 | 2 | 87 | 93 |

[a] Title 49 *CFR* 830.2 defines *fatal injury* as “any injury which: results in death within 30 days of the accident” and *serious injury* as “any injury which: (1) requires hospitalization for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burn affecting more than 5 percent of the body surface.“ The *minor injury* category in this report includes all other people, not cited in the other injury categories, who were reported treated by area hospitals within 24 hours following the incident. In the table above, “none” indicates individuals who were examined at a hospital, but no injury diagnosis was made and “unknown” indicates occupants whose records could not be found.

Overall, 90 of the 149 (60.4 percent) occupants of Amtrak train P91 were injured in the collision. Both crewmembers on the locomotive died. Among the four crewmembers riding in the passenger cars, one was seriously injured, and three had minor injuries.

Seven of 32 passengers ticketed in roomettes or bedrooms and 77 of 109 of passengers ticketed in coach seats were taken to hospitals and found to be injured. None of the passengers ticketed in roomettes or bedrooms was seriously injured, but one seriously injured crewmember reported to his health care providers that he had fallen out of an upper bunk. According to the

[18] In Lexington County, there are four PSAPs that are divided up into the following areas: Cayce, West Columbia, Batesburg, and all of Lexington County.

medical records, most of the passengers reported having been asleep or resting; those in seats were thrown out of their seats and against the furniture in front of them. The majority of soft tissue injuries (lacerations and contusions) were to the face, head, and knees or shins. Two people had broken teeth; one had a broken nose, and one had a facial fracture. Of those seriously injured passengers, three reported falling against the edge of a table.

## 1.6 Damage

Amtrak reported damages to be about $25.4 million. CSX reported its equipment damage at $350 thousand.[19]

## 1.7 Weather

At 1:56 a.m., the Columbia weather observation was wind from the east at about 8 mph, visibility 10 miles or more, broken clouds at 5,000 feet, and overcast clouds at 6,000 feet, with a temperature of 40°F (4°C), dew point of 19°F (-7°C), and a relative humidity of 45 percent.

## 1.8 Personnel

### 1.8.1 Amtrak Engineer

The Amtrak engineer was hired on May 13, 2013, and he was promoted to a certified engineer on March 2, 2017. He passed his most recent certification exam and a territorial physical characteristic exam (no specific date was provided). His last medical exam, including a comprehensive medical history, review of medications, vital signs, and a physical exam as well as hearing and vision testing, was dated May 26, 2017. The Amtrak engineer had reported having type 2 diabetes and high cholesterol, which had been being treated with medication since 2006. His last skills performance evaluation was on September 29, 2017, and his last efficiency test observation was on January 22, 2018.

The Amtrak locomotive engineer was experienced, certified, and qualified to perform his duties. The engineer was off duty for 5 consecutive days prior to reporting for duty for Amtrak train P91. There was no evidence that he was fatigued. Postaccident toxicology tests identified sitagliptin and atorvastatin in urine and blood.[20] Sitagliptin is a medication used to treat diabetes and atorvastatin is used to treat high cholesterol. Neither are considered impairing.[21] The Amtrak engineer's glucometer test results were reviewed for the 3 weeks before the accident; he had no

[19] This amount was confirmed in a June 11, 2019, by the FRA to the NTSB.

[20] In addition to the FRA-mandated testing, the NTSB had specimens from the deceased Amtrak train crew tested by the Federal Aviation Administration (FAA) Forensic Sciences Laboratory. This lab has the capability to test for more than 1,300 substances including toxins, common prescription and over-the-counter medications as well as illicit drugs. (See http://jag.cami.jccbi.gov/toxicology/default.asp?offset=0 for a complete listing.)

[21] (a) The National Institutes of Health. U.S. National Library of Medicine. DailyMed. Janumet. (Sitagliptin and metformin combination) https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=d19c7ed0-ad5c-426e-b2df-722508f97d67. (b) National Institutes of Health. US National Library of Medicine. DailyMed. Atorvastatin. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=6ccdb6f3-22c7-5b48-46bc-ce4a4c65eb4d.

episodes of hypoglycemia. Postmortem, his hemoglobin A1C was 7.5 percent, indicating good to fair control of his diabetes.[22] The engineer had no previous disciplinary action.

### 1.8.2 Amtrak Conductor

The Amtrak conductor (in the locomotive) was hired on March 4, 2008, and was promoted to a certified conductor on July 19, 2016. He passed his most recent certification exam June 22, 2016, and a territorial physical characteristic. His last medical exam including a vision and hearing assessment was on May 5, 2016. His last efficiency test observation on October 4, 2017.

The Amtrak conductor was experienced, certified, and qualified to perform his duties. He worked less than 8 hours each of the 2 days prior to the Amtrak train P91 duty. He was off duty for 3 consecutive days prior to that. There was no evidence to suggest that he was fatigued. He had no identified medical conditions. Postaccident toxicology tests identified diphenhydramine in urine and 0.0297 microgram/milliliter of diphenhydramine in heart blood. Diphenhydramine is a sedating antihistamine and carries a warning about operating machinery. However, it undergoes significant postmortem redistribution, and heart blood levels may not represent antemortem levels (Han 2012). Diphenhydramine was not a factor in this accident. The conductor had no previous disciplinary action.

### 1.8.3 Amtrak Assistant Conductor

The Amtrak assistant conductor (in the lounge car) was hired on June 10, 2013. He passed an operating rules exam on December 14, 2017. His last efficiency test observation was on September 27, 2017.

The Amtrak assistant conductor was experienced, certified, and qualified to perform his duties. He worked for 9 hours 35 minutes on the day prior to reporting for duty on Amtrak train P91. Prior to that, he was off for 5 consecutive days. There was no evidence that he was fatigued. The FRA postaccident toxicology tests were negative for alcohol or other tested drugs. The conductor had no previous disciplinary action.

### 1.8.4 CSX Engineer

The CSX engineer was hired in November 2000 and was promoted to a certified engineer on December 31, 2016. He passed his most recent certification exam and a territorial physical characteristic exam. His last skills performance evaluation was on January 4, 2018, 1 month before the accident date. In 2010, records show an evaluation for return to work following foot surgery in which he mentioned having high blood pressure. During his last medical evaluation, he confirmed that he had not “been treated by a physician for any condition(s) that could affect” his “ability to safely perform the essential functions” of his job and vision and hearing testing was

[22] Hemoglobin A1C is a measure of the percentage of hemoglobin molecules that have a glucose molecule attached to them (what percentage have been glycosylated). It is used as a measure of average blood glucose over the preceding several weeks. Nondiabetic levels are below 5.4 percent. Between 5.5 and 6.4 percent is considered “pre-diabetes,” and above 6.5 percent indicates diabetes. For diabetic individuals, levels below 7.0 percent are considered “good control.”

performed on March 17, 2016. No measurement of his blood pressure or any other vital sign was documented in his CSX occupational medical records after 2010.

The CSX locomotive engineer was experienced, certified, and qualified to perform his duties. He had maintained a regular work and rest schedule for several days leading up to the accident, and there was no evidence that he was fatigued. The FRA-mandated toxicology tests were negative for alcohol and other tested drugs.[23] The engineer had no previous disciplinary action.

### 1.8.5 CSX Conductor

The CSX conductor was hired in 2014, and he was promoted to a certified conductor on December 31, 2016. He passed his most recent certification exam and a territorial physical characteristic exam. His last medical evaluation, dated May 12, 2016, was limited to him confirming that he had not "been treated by a physician for any condition(s) that could affect" his "ability to safely perform the essential functions" of his job and vision and hearing assessments.

The CSX conductor was experienced, certified, and qualified to perform his duties. He had maintained a regular work and rest schedule for several days leading up to the accident, and there was no evidence that he was fatigued. He had no medical conditions identified by CSX, and FRA-mandated toxicology tests were negative for alcohol and other tested for drugs. The conductor had no previous disciplinary action.

## 1.9 Operations

### 1.9.1 Operating Documents

The crews were governed by the following documents containing the operating rules and procedures: *CSX Employee Operating Manual*, effective April 1, 2017; *CSX Columbia Subdivision Bulletin No. 1*, effective April 1, 2017; and *CSX Columbia Subdivision Bulletin No.105*.

The CSX signal department was in the process of making modifications to the signal system between MP S 362.5 and MP S 385.1. To accomplish the signal upgrades, the signal system was suspended, and absolute blocks were established. Within the limits of the signal suspension, train movements were governed by—

- Operating Rules 504.36 and 504.37.[24]
- TWC/TWC-D – A method of authorizing movements or protecting employees or on-track equipment in a signaled or non-signaled territory on a controlled track within specified limits when the authority for movement on that track is designated in a special

[23] FRA postaccident toxicology testing includes a drug screen of urine. If there are positive findings, confirmation testing is performed on blood. Testing includes drugs in the following categories: amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, opioids, phencyclidine, and sedating antihistamines.

[24] CSX Operating Rules 504.36 and 504.37 address use of an EC-1 and trains operating during a signal suspension, respectively. See appendix D for relevant CSX operating rules.

instructions dispatcher message or Form EC-1 as TWC (signaled) or TWC-D (non-signaled). Train movement in the territory is governed by verbal authority from the train dispatcher.

- Form EC-1 – A form used to record specific instructions or dispatcher messages from the train dispatcher regarding movements on controlled tracks.
- Special Instructions – Information contained in timetables, system bulletins, division bulletins, and CSX procedural instruction manuals.

At the time of the accident, the dispatcher was using TWC-D as an alternate method of operation in conjunction with an EC-1 form as governed by Operating Rule 505.[25] The maximum authorized speed under TWC-D was 59 mph for passenger trains and 49 mph for freight trains. Trains moving within the signal suspension limits did not have to proceed at restricted speed. The EC-1 form was used to control train movements from the SAS at Holdout (MP S 362.5) to, but not including, the SAS NE Woodford (MP S 385.01).

### 1.9.2 Dispatcher Instructions

Prior to the initiation of the signal suspension, CSX issued the following instructions or checklist to the FF desk dispatchers for their guidance.

When a signal system is suspended, and an alternate method of operation is in effect:

1. Obtain a job briefing to understand the limits, the alternate method of operation, and any PTC requirements.

2. If necessary, instruct the first movement through the limits to stop at all power operated switches; secure the switches in hand position as outlined either by dispatcher message or special instructions.

3. Before issuing the authority:

    a. Ascertain the employee was job briefed and understands the method of operation. If the employee has not been job briefed or does not understand, stop the movement and perform the necessary job briefing.

    b. If there are drawbridges or railroad crossings at grade within the limits of the signal suspension remind the employee to stop at these locations or be governed by the dispatcher message or special instructions.

[25] Operating Rule 505 – Track Warrant Control Non-Signaled: “When the authority for movement on a controlled track is designated in special instructions, dispatcher message, or Form EC-1, such as a TWC-D, trains will be governed by verbal authority from the train dispatcher.”

c. When a switch tender is on duty, confirm they:[26]

(1) Understand the movement to be made,

(2) Have properly lined the switch(es), and

(3) Instruct the train crew to confirm the switch tender switch(es) are properly lined for their movement.

(4) Issue the authority prior to lining into the suspension limits.

### 1.9.3 Dispatcher Operating Rule Requirement

The CSX train dispatchers were required to follow Operating Rule 608.8 (See appendix D.), which addresses the procedure for operating hand-throw switches in non-signaled territory as follows:

When hand-operated switches are used in Track Warrant Control Non-Signaled territory (TWC-D), the train dispatcher must use the train dispatcher radio to confirm:

1. Location of the switch(es) operated,
2. Switch(es) were restored and locked in normal position,
3. Time switch(es) were initially reversed,
4. Time switch(es) were restored and locked in normal position,
5. Name of the employee who operated the switch(es), and
6. The Switch Position Awareness Form (SPAF) was initialed by both the conductor and locomotive operator.

## 1.10 Track Description

The CSX Columbia subdivision consists of 137.5 miles of single main track between MP S 359.7 and MP S 497.2. CSX inspects and maintains the main track near the accident location to FRA Track Safety Standards (TSS) for Class 3 track. The Silica Storage track where the collision occurred is inspected and maintained to FRA Class 1 standards, which allow maximum operating speeds of 10 mph for freight trains. In accordance with CSX operating rules, the speed in the Silica Storage track is restricted to 10 mph for freight trains, and passenger trains are not routinely operated on the storage track. Amtrak operates 2 passenger trains (one northbound and one southbound) over this subdivision 7 days a week.

[26] A *switch tender* is an operating employee assigned to throw switches, which are generally remotely controlled power switches that have been placed in the manual mode of operation. A switch tender communicates with a dispatcher about which switch to throw and then reports its position to the dispatcher.

Traveling on the main track, the southbound Amtrak train traversed a grade ranging from 0.0 to 1.01 percent beginning at MP S 366.0 to the point of collision (POC) at MP S 367.1. The main track curvature leading up to the POC from MP S 366.0 was mostly tangent track with five curves ranging from 2.15 degrees to 0.27-degree curvature.

### 1.10.1 North End Silica Storage Track Switch

To provide entry into the north end of the Silica Storage track, CSX maintains a switch there. The switch points of the turnout are controlled by a hand-operated switch stand equipped with an electric lock. Operation of the Cayce main track electric lock requires railroad personnel assigned with a proper key to unlock a padlock and release a foot pedal.

With the padlock removed, a coil return spring raises the foot pedal and energizes the locking circuit. The locking circuit energizes a timer that runs a predetermined time before lifting a locking bar or bayonet that allows the hand-throw switch to be thrown. Rail equipment occupying the Silica Storage track would have to run a 10-minute timer before being able to manipulate the hand-throw switch and occupy the main track. Rail equipment on the main track would occupy an overlay circuit that runs a 20-second timer to run before being able to manipulate the hand-throw switch and move off the main track and into the Silica Storage track.

Prior to the accident, the CSX crew used the electric lock to enter the Silica Storage track from the main track. The CSX train crew waited 20 seconds, threw the hand-throw switch to the reverse position, and entered the Silica Storage track to complete its switching assignments.

The timer circuit for the Silica Storage track was last tested by CSX signal personnel on July 19, 2017, and was in accordance with FRA regulations.

Figure 9 provides a view of the Silica Storage track looking south at the main track with the Silica Storage track switch in the foreground and the auxiliary track going off to the right of the main track. The switch is as found, lined in the reverse position (allowing movement into the Silica Storage track). The rear of the Amtrak accident train can be seen in the background about 100 feet from the switch.

**Figure 9.** South-facing view of the North End Silica Storage track switch.

### 1.10.2 Silica Storage Track

The Silica Storage track extends from MP S 366.9 (north switch) to MP S 367.9 (south switch) and is about 5,000 feet long. Investigators took track geometry measurements at this location, and the track gage was measured by documenting the location of the rail plates. Investigators found no evidence of noncompliance with the FRA and the CSX standards that existed prior to the accident. The photograph in Figure 10 shows the track damage and unseated rail near the derail at the north end of the Silica Storage track. The main track and the switch at the north end of the automobile lot runaround track are at the left in the photograph.

**Figure 10.** Track misalignment damage near derail at north end of the Silica Storage track.

### 1.10.3 Point of Collision

The POC was near MP S 367.1 in the Silica Storage track. The train traveled about 660 feet south into the storage track before striking the stationary CSX train.

### 1.10.4 Records Inspection/Testing of Track

On February 5, 2018, investigators conducted an inspection of the track from MP S 366.6 to MP S 367.05. Investigators reviewed the data from the rail and geometry tests and did not take any exception. Investigators did not take exception to a review of CSX's FRA-related inspections records and documents. CSX conducted a survey of the Columbia subdivision using a geometry test vehicle on January 10, 2018. There were no geometry defects identified in the accident area during this test.

## 1.11 Mechanical

### 1.11.1 Train Consists

The CSX local train, F777, consisted of 2 locomotives and 34 empty auto rack freight cars. CSX130 was the locomotive that was struck, and the second locomotive was CSX36. The train weighed about 4.3 million pounds.

Amtrak train P91 consisted of one locomotive, three passenger coaches, one lounge car, two sleeper cars, and a baggage car. The train weighed approximately 1,119,000 pounds and was about 667 feet in length. The train consist is shown in table 3.

**Table 1.** Amtrak train P91 consist.

| Position | Car Type | Number | Capacity |
|---|---|---|---|
| 1 | Locomotive | 47 | 2 |
| 2 | Passenger Coach | 25037 | 59 |
| 3 | Passenger Coach | 25072 | 59 |
| 4 | Passenger Coach | 25020 | 59 |
| 5 | Lounge Coach | 28002 | 49[a] |
| 6 | Sleeper Coach | 62012 | 30 |
| 7 | Sleeper Coach | 62008 | 30 |
| 8 | Baggage Coach | 61048 | 0 |

[a] These seats are not sold.

### 1.11.2 Amtrak Locomotive

Amtrak locomotive AMTK47 is a General Electric (GE) Genesis P42-8 type diesel passenger locomotive. The unit weighs 268,240 pounds and can operate at a maximum speed of 110 mph. It carries 2,200 U.S. gallons of diesel fuel, with an integrated fuel tank on each side of the locomotive. The Genesis braking system is the New York Air Brake (NYAB) Computer Controlled Brake (CCB I) system. Amtrak uses the P42 as the main motive power for its nonelectrified tracks around the United States.

Amtrak's entire locomotive fleet that operates long distance service is in the process of undergoing PTC activation, with one of those systems being Interoperable Electronic Train Management System (I-ETMS), which will be the PTC system implemented in the territory of the incident. This will allow Amtrak locomotives to seamlessly communicate with CSX wayside equipment and both CSX and Amtrak PTC back office environments. I-ETMS was installed on the locomotive AMTK47 in September 2014; however, the CSX wayside and back office equipment were not yet operational.

The P42-8 carbody is comprised of four major elements: platform, side walls, front cab, and three detachable roof sections. It is designed to withstand a static compression force of 800,000 pounds and is equipped with an Association of American Railroads (AAR) F-type coupler.

### 1.11.3 Passenger Cars

Amtrak passenger coaches involved in the derailment were designated as Amfleet II cars, built by the Budd Company (Philadelphia, Pennsylvania). They were placed into regular mainline service in 1983. The sleeper coaches were designated as Viewliner cars.

The Amfleet II carbody structure, apart from the high-strength, low-alloy steel (HSLA) end underframe and cross bearers, is constructed entirely of stainless steel. The exterior skin is formed in corrugations for strength and appearance. Only in the window areas are flat formed panels used. At the time they were built, the carbody strength exceeded all the applicable AAR and FRA requirements, including a full 800,000-pound compression load applied at the draft gear and lateral anti-climbers. Additionally, to improve the strength of the cars, the end collision post assemblies exceeded the AAR requirement at the time the cars were constructed by designing these assemblies for an ultimate horizontal load of 300,000 pounds (applied 18 inches from the floor and at a 15° angle). The vertical end collision posts are constructed of stainless steel and are located on either side of the end door openings. They are fastened securely into a horizontal end plate at the top and are welded to low-alloy, high-tensile (LAHT) steel stubs extending up from and welded to the end underframe at the bottom.

The Amfleet II coach cars have seats for 59 passengers, and the Viewliner sleeper cars have 16 rooms. There are eight emergency egress windows in each Amfleet II coach car. The Viewliner sleeper cars have an emergency egress window in each room. At one end of the car, the Amfleet II and Viewliner cars have a side door on each side of the vestibule. Passenger Safety Information cards are in the coach seat pocket and each sleeper room. Each car has light sticks, a fire extinguisher, a pry bar, and a first aid kit.

### 1.11.4 CSX Locomotive

The CSX lead locomotive, CSX130, and the train locomotive, CSX36, are GE-manufactured AC4400CW-type diesel locomotives. The AC4400 operates on the standard gauge with a wheel diameter of 42 inches and two three-axle trucks. The braking system is NYAB CCB-I.

### 1.11.5 Equipment Preaccident Inspection

#### 1.11.5.1 Amtrak Train P91

Amtrak train P91 underwent an FRA Class I air brake test by qualified inspectors at 12:10 a.m. on February 3, 2018 in accordance with 49 CFR 238.313 Class I Brake Test. The long-distance consist of coach, lounge, sleeper, and baggage cars was equipped with an Amtrak City Sprinter (ACS64) Locomotive AMTK665 in electrified territory until Washington, DC, when the locomotive was replaced with the P42-8 diesel locomotive AMTK47 for the continued trip south.

Prior to departing Washington, DC, the FRA-required completion of a predeparture check in accordance with 49 CFR 232.211 Class III Brake Tests-Trainline Continuity Inspection. Inspection records recovered after the accident showed the inspection was completed on February 3, 2018, at 9:28 p.m., when the lead locomotive was changed.

#### 1.11.5.2 CSX Train F777

CSX train F777 originated at Cayce, South Carolina; its prior designation had been Q211-01. When the Q211-01 departed Louisville, Kentucky, destined for Cayce, an FRA Class I air brake test was completed on February 1, 2018, at 10:30 a.m. The train consisted of the CSX36 and CSX130, with 56 loaded cars. Q211-01 had several crew changes en route to Cayce. That train departed Greenwood, South Carolina, on February 3, 2018, at 8:01 a.m. and arrived at Cayce on

February 3, 2018, at 12:54 p.m. with 46 loads and 2 empties. The train consist was then changed to the F777, which consisted of two locomotives, and 34 unloaded auto rack cars.

#### 1.11.5.3 Records Review

Investigators collected the daily and periodic inspection records from the locomotives involved in the collision and locomotive AMTK665, which was the locomotive of Amtrak train P91 at its point of origination in New York City on February 3, 2018. The daily inspection requirements are outlined in 49 *CFR* 229.21. The rule requires that, except for multiple unit (MU) electric locomotives, each locomotive in use shall be inspected at least once during each calendar day.[27] Investigators reviewed the daily inspection records for the locomotives AMTK665, AMTK47, CSX130, and CSX36 and found no exceptions.

Periodic inspection requirements for locomotives are outlined in 49 *CFR* 229.23. Each periodic inspection is to be recorded on either FRA form F6180-49A. At the first periodic inspection in each calendar year, the carrier shall remove from each locomotive the F6180-49A covering the previous calendar year and replace it with a current record that will cover the current year. The inspection interval for these locomotive types is 184 days. Investigators reviewed the periodic inspection records for the locomotives involved in this accident (AMTK47, CSX130, and CSX36) and the originating locomotive for Amtrak train P91 (AMTK665). The records noted no exceptions.

## 1.12 Damage Description

### 1.12.1 Overview

When the trains collided head on, the Amtrak locomotive, AMTK47, overrode the CSX locomotive, CSX130, toward the east side (or toward the main track). The lead truck and engineer’s side of the cab of CSX130 were sheared off by the Amtrak locomotive as it came to rest on its left side. The cab of locomotive CSX130 was crushed, and the CSX train was pushed backward about 15 feet from the point of collision. Figure 11 shows the position of the two trains.

[27] An *MU locomotive* is a multiple unit–operated electric locomotive (1) with one or more propelling motors designed to carry freight or passenger traffic or both or (2) without propelling motors but with one or more control stands and a means of picking up primary power such as a pantograph or third rail.

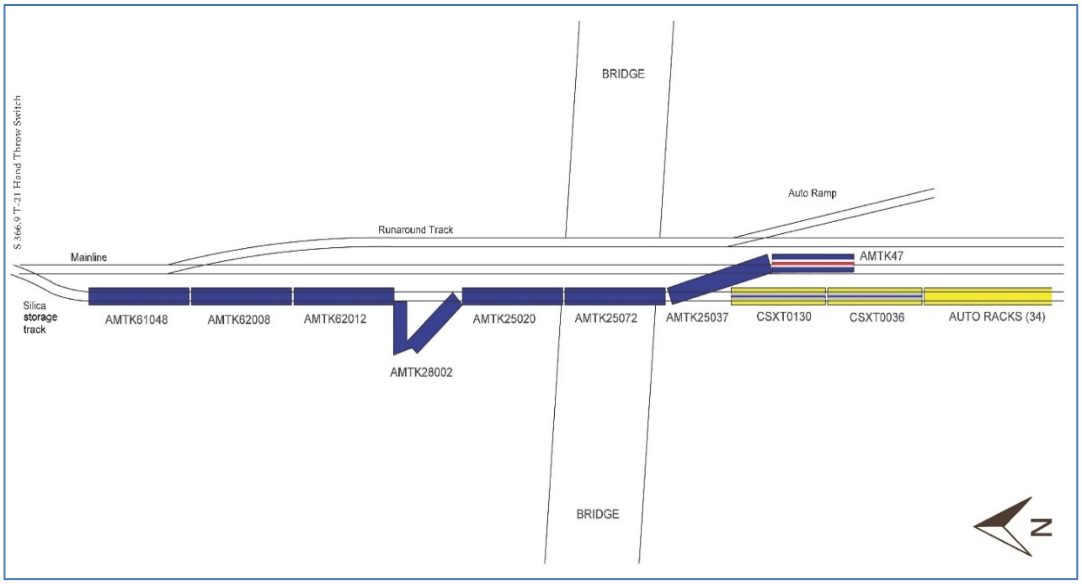


**Figure 11.** Illustration of the resting position of the trains.

The Amtrak wreckage continued to decelerate for about 130 feet beyond the point of collision, shoving the lead coach car into the air as the Amtrak locomotive rolled left. The trucks of the first coach were broken off and came to rest under the car. Figure 12 shows the first passenger coach, which was not occupied at the time of the collision; the lead coach buckled slightly as it lodged into the rear of the Amtrak locomotive. The second coach remained upright but derailed and buckled. The third coach remained on the rail without significant damage.

**Figure 12.** Photograph showing first passenger coach.

The lounge car, shown in figure 13, was forced off the Silica Storage track and bent laterally, shearing open the left side of the car and crumpling the right side.


**Figure 13.** Photograph of the lounge coach.

The two sleepers following the lounge were derailed upright with minor damage, and the baggage car’s first truck came off the rail, coming to rest just inside the north end switch.

### 1.12.2 Postaccident Inspection

CSX locomotive CSX36 was separated from CSX130 along with the 34 auto rack cars. A Class 1 airbrake test was performed on the 34 empty auto racks and 1 locomotive (CSX36). The test was completed, and no defects were observed. The test for the brake pipe leakage found no defect.

The inspection of AMTK47 continued with the visual inspection for artifacts from the debris field of the area and the locomotive body. This included identification of the major components of the truck assemblies. The damage was extreme; neither inspections nor tests were deemed possible to provide any conclusive results. No significant findings were observed.

A preliminary assessment of the wrecked Amtrak passenger cars was conducted at the equipment’s resting place, followed by inspections after the equipment had been moved to the nearby staging area. Truck assemblies, wheels, brake systems, couplers, and car structure were all inspected.

AMTK25037 (coach) was inspected, and it was found to have the A-end truck and bolster detached from the carbody. The bolster had separated from both the truck and carbody and had taken the A-end right anchor arm and a section of the car's side sill with it. The car structure buckled upward, deforming the center sill, side sills, roof, and floor structure of the car about 25 feet from the A end of the car. Undercar equipment boxes were crushed as the car rode over its A-end truck assembly. There were no notable defects of the truck assemblies, wheels, brakes, couplers, or carbody that appeared to have been present prior to the crash.

AMTK25072 (coach) was found to have the floor buckled in multiple places and some exterior damage. The trucks and wheels were damaged when the car derailed, but there were no notable defects for the trucks, wheels, brakes, couplers, or carbody that appeared to have been present prior to the crash.

AMTK28002 (lounge) was bent in half and sustained full separation of the left-side sill, wall, and roof. The center sill of the car was significantly deformed but remained connected. The right-side sill was crushed at the interior of the bend. Both trucks derailed and had significant damage from the derailment but remained intact and connected to the carbody. The truck and carbody brake components all showed evidence of damage resulting from the derailment. Both couplers remained with the car and were intact. There were no notable defects to any of those components that appeared to have been present prior to the crash.

Amtrak coach AMTK25020, the two sleeper cars, and the baggage car were deemed repairable and were moved to the north end of the nearby runaround track, where investigators performed inspections.

AMTK25020 (coach) had damage to the B-end right-side carbody where it had collided with AMTK28002. AMTK62012 (sleeper) had damage to the A-end left-side butt line and the A-end right-side truck anchor fixture sheared from the side sill (carbody bolts sheared off). The B-end coupler was broken off behind the horn and was replaced. The butt line carbody and vestibule were damaged where it collided with AMTK28002. AMTK62008 (sleeper) had damage to B-end left-side and A-end right-side anchor arms (carbody bolts sheared off). AMTK61048's (baggage car) front trucks had derailed but did not sustain significant damage.

The passenger equipment deemed repairable received an AAR Class I brake test with zero brake pipe leakage prior to moving to Cayce Yard. All observations found on this passenger equipment were consistent with postaccident damage. The following passenger equipment was repositioned onto the staging area: truck assemblies, wheels, brake system components, couplers, safety appliances, and car structures. All equipment was inspected to determine whether any preexisting damage or defects may have contributed to the accident.

Investigators observed all wheels on all equipment were full and had full flanges and normal wheel tread wear. None of the equipment showed evidence of wheel flats or flat marks on the wheel's tread. All undamaged brake rigging appeared normal, and all brake pads and discs appeared to be within tolerance.

# 1.13 Signals

## 1.13.1 CSX Columbia Subdivision

In the accident area, CSX operates trains using a traffic control system (TCS) system in accordance with CSX Operating Rule 510.[28] Prior to the suspension, the TCS system included Electrocode 4, used to detect train occupancy using a direct current–coded track circuit and to detect train position and effect signals and switches traversed by trains. There are two types of switches in the subdivision: remote controlled switches and hand throw switches. Remote controlled switches were operated by the dispatcher using Union Switch & Signal (US&S) M23 and M22 switch machines. Electric Lock 4 was used in conjunction with the US&S T-21 hand throw switches equipped with electric locks and derails that are not controlled by the train dispatcher but would display a track circuit light on the dispatcher's board if they are not in the normal position. Wayside signals were colored light signals.

## 1.13.2 Temporary Signal Suspension

On the day prior to the accident, there was a temporary signal suspension in place that began at 7:00 a.m. on February 3, 2018. A signal suspension was required to make modifications to the signal system. The temporary signal suspension was proposed by the signal department personnel and accepted by the CSX operations officers to install electronic track circuits and frame communications circuits as well as PTC-compatible microprocessor-based vital logic controllers and replace signals. According to testimony given by the CSX service test engineer, the temporary signal suspension would be in effect for about 1 1/2 days. He stated, "It was planned. The suspension was supposed to take approximately a day and a half. I had authorization to do it through about 2 days."

The signal system had been suspended by a signal manager at 7:23 a.m. on February 3, 2018. According to testimony given by the CSX director of service test engineering, the signal department had 43 signal contract personnel and 5 CSX managers on hand to assist with the signal upgrade during the signal suspension. Additionally, CSX used a contractor to serve as a liaison to the operating department at the dispatching office. During the signal upgrade, trains entered the limits of the temporary signal suspension three times while CSX signal personnel were trying to complete the cutover. According to testimony by the CSX service test engineer the train movement totaled about 6 hours inside the temporary signal suspension limits and thus caused delay in the completion of the cutover (certain signal testing functions could not be performed with equipment occupying the main track). After the accident and the cleanup, on February 6, 2018, the signal cutover was completed in about a 2-hour period, and the temporary signal suspension was lifted.

During the signal suspension, the vital signal system was considered disrupted until all signal testing was completed, and the signal system was restored back into service. Although the CAD displays in the dispatching center continued to provide a regenerated view of signal system indications, dispatchers could not rely on those indications while the signal system was suspended.

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[28] According to CSX Operating Rule 510, traffic control (TC) is when the authority for movement on controlled tracks is designated in special instructions, dispatcher message, or Form EC-1 as TC; general signal rules are also in effect, and signal indication authorizes and governs train movements in either direction.

Signal suspension instructions did not allow dispatchers to issue train movement authorities using the CAD system. A vital signal system cannot be partially restored back to service until testing of all signal devices and appurtenances is completed. Although the CAD display indicated track occupancies, the dispatchers could not differentiate between a train occupancy or a disrupted signal circuit. The CSX train dispatcher was unable to use the CAD track occupancy lights as an indication of the locations of any trains within the limits of the signal outage.

### 1.13.3 Signal System Examination and Testing

The accident inspection found all signal equipment secured, with no indications of either tampering or vandalism. Inspection of the switch located at MP S 366.9 found there was no damage to either the T-21 switch or the electric lock. The switch was found in the reverse position with a pad lock in the latch stand and the bayonet (locking device) in the foot pedal. The switch was tested and worked as intended. Investigators found the derail in conjunction with the switch had damage to the connecting rod (bent), broken derail, and wires pulled out of the junction box and broken. There were no defects noted during the examination of either the T-21 switch or the associated signal appurtenances.

## 1.14 Human Performance

### 1.14.1 CSX Train Crew Work History

Neither the engineer nor the conductor worked more than 4 days in a row without a day off in the 10 days leading up to the accident. On the days that they did work, every shift started at 3:30 p.m. There was no variability in their shift start times. Both had at least 15 hours off between each shift.

### 1.14.2 Work Familiarity

The CSX engineer stated that he and the conductor had worked together in the past although not on a regular basis. They reported a good working relationship with each other. The engineer indicated that it had been about 1 1/2 years since he had last completed a job similar to the one performed on the day of the accident. The conductor stated that he had completed the job multiple times in the past month, but the signals had always been operational. Thus, their shift would be the first time that he completed the job using EC-1 authority.

When using EC-1 authority, it is necessary to report the time that each switch is realigned to the main track on a SPAF. The CSX conductor stated that the additional time required to complete this process was minimal, but noted that “I prefer signals a lot of times because you don't have to write down the EC-1s and, you know, the dispatcher doesn't catch you off guard and ask you where you're at, and you're not really sure where you're at and have to, you know, ask your engineer and stuff.” The conductor also indicated that operating with EC-1 authority was slightly more challenging than operating with the normal signals. However, he also said, “Sometimes the

EC-1 authority is good if you have a large amount of track that you're in, that you're the only one in there; then you don't need to worry about signals."[29]

The CSX engineer indicated that using EC-1 authority required the use of a different set of operating rules. He said that using EC-1 instead of normal signaled operations was more challenging, and a "little more aggravating," because it required more communication with the dispatcher. The CSX engineer stated that trains still operated at track speed when EC-1 authority was used. He said that he had no safety concerns about using EC-1 authority, but rather it was more of a matter of inconvenience compared to normal signaled operations.

### 1.14.3 Work Factors

The conductor reported that he was alert, clearheaded, and focused on the task during his work shift; however, he also reported that he had become overly warm after engaging in extensive physical effort working with a piece of rusted equipment. As a result, he had taken off his jacket.

While completing his work in the hours leading up to the accident, the CSX conductor recalled that he did not feel like he was rushing himself, but he said, "it wasn't a relaxed pace," and there was "a lot to do." He said he felt a sense of urgency because of the number of switching operations that he needed to perform, and he was not sure how long it was going to take him to complete the work. He said that he knew that his work needed to be completed before an Amtrak train arrived at 2:00 a.m. (February 4, 2018).The conductor told investigators that because his watch was broken, he had asked the engineer on duty with him to keep track of time (keeping the times entered on the SPAF). He recalled the engineer reporting to him when it was about 1:00 a.m. Around that time, he encountered an issue with one of the cars. As a result, he had to complete another switching movement. At that point, he recalled thinking, "There's more switching than I thought." However, he also recalled thinking that there was enough time to complete his work before the Amtrak train reached his location after hearing the dispatcher state via the radio that the train had reached Camden.

### 1.14.4 Switch Position Awareness Form

A catastrophic accident in Graniteville, South Carolina, on January 6, 2005, resulted in nine fatalities and the release of chlorine gas. In response, the FRA issued Emergency Order 24 (EO 24), on October 19, 2005, mandating the SPAF. A month later (November 25, 2005), the FRA issued a clarifying amendment, which stated (in part): "The purpose of EO 24 was to establish responsibility, shared among the crew and the dispatcher, for confirmation of switch position for all switches operated before the authority is released."

However, the FRA later realized that the SPAF was ineffective and eliminated the requirement. On December 28, 2012, in a letter to the NTSB, the FRA explained that it had found many instances in which the SPAF had been filled out, but it did not reflect the actual position of the switch (that is, the switch was not realigned to its normal position). Conversely, the FRA had also found many instances in which main track switches were lined and locked properly, but train

[29] For more information on any of the interviews discussed in this report, see interview transcripts in the NTSB public docket DCA18HR001, accessible from the NTSB Accident Dockets web page.

crews had failed to complete a SPAF. Moreover, the FRA stated that the SPAF requirement created a paperwork burden and could not be economically justified. The FRA replaced the SPAF requirement with individual crew job briefings, "to create a contemporaneous communication every time an employee operated a hand-operated switch in non-signaled territory while employees were still at the switch." Although the FRA has removed the requirement to complete a SPAF, the CSX operating rules still required that one be completed during a signal suspension.[30]

Investigators did not recover a SPAF from the accident location. The CSX conductor told investigators that he was providing information to the CSX engineer so that the engineer could physically fill out the form. However, the conductor also said that "the switch times and stuff was a mess." He stated that this was because he forgot to report the time that he realigned each switch to the engineer. He suggested that he may have forgotten because completing the SPAF was not part of his usual work routine. He also stated that he was not sure which milepost number corresponded to each switch. However, the conductor believed he had realigned both switches and stated, "I knew I had it locked up, and that's all that really mattered in my mind, you know." The conductor said that he told the engineer to "report the switch time as your time. You know, both those switches have been restored at your time."

The engineer said that he completed most of the SPAF but that the conductor "may have filled out something. He said he had to put something there." The engineer also said that he maintained possession of the SPAF, except when the conductor used it while contacting the dispatcher to give up control of track. The engineer said the completion of a SPAF was not a part of his usual work routine, and it had been about 2 1/2 years since he last completed one.

### 1.14.5 CSX Conductor's Reflection on the Events

The CSX conductor told investigators that, prior to the accident, he believed that he had realigned the T-21 switch to the mainline track. However, after the conductor spent some time thinking about what had occurred, he acknowledged that he probably had failed to do so. In his accident conversation with investigators, the conductor indicated that a work pattern had become "second nature" or like a "habit" to him, and this might have interfered with his intentions. He talked about the night in which he had been repeatedly getting up and down from the locomotive. He also described a work pattern that he was used to "in the yard." He and an engineer would throw a switch and shove back into it and then lock it up. He suggested that, perhaps, on the night of the accident, he thought to himself that he was locking up for the night and failed to realize that he needed to remain at the switch (not ride the locomotive back), and then realign the switch back to the main line.

## 1.15 Amtrak Operations on Host Railroads

### 1.15.1 Differences in Operating Rules

The national railroad passenger transportation system consists primarily of Amtrak-owned and -operated property on the Northeast Corridor as well as passenger train operations over 29

[30] A blank CSX SPAF is shown in appendix C.

different host railroads that comprise about 97 percent of the national network for regularly scheduled services. Because Amtrak does not own the host railroad property, Amtrak operates under host railroad agreements with the various host railroads. The differences in operating rules of the various host railroads and challenges it presents were discussed with senior Amtrak officials.

The NTSB conducted interviews with Amtrak's chief operating officer (COO); vice president, safety, compliance and training; chief safety officer; and president and chief executive officer (CEO) at NTSB headquarters between March 26 and April 1, 2019. Factual information from these interviews is presented in the following sections.

#### 1.15.1.1 Chief Operating Officer – Amtrak

Amtrak's COO was asked to compare the practices of Amtrak prior to and following the Cayce accident. He discussed the changes that Amtrak implemented concerning signal suspensions. He said that, prior to the accident, Amtrak trains moving through signal suspensions on a host railroad would follow the host railroad rules.

He further stated that, after the accident, Amtrak changed its operating practices. Upon learning that a signal suspension was in place on a host railroad, Amtrak would "go through a risk mitigation process." He said that Amtrak is responsible for its crews and passengers and "if we believe there is a better way to run [than] just following the operating rules of the host, then that's the way we have to run."

The COO said that Amtrak recognized the need for a change almost immediately after the Cayce accident occurred. He said that within a few days of the accident, or perhaps even on the day of, Amtrak began questioning its practice of following the host railroad operating rules without completing a risk analysis. He said that, on the Northeast Corridor, which is Amtrak-owned property, trains would be run prepared to stop during a signal suspension.[31] He asked, referencing operations on CSX property, "Why would we [do] it any differently there?"

#### 1.15.1.2 Vice President, Safety, Compliance and Training – Amtrak

Investigators spoke with Amtrak's vice president, safety, compliance and training about Amtrak's practices prior to the Cayce accident, as well as its efforts to implement safety improvements. He acknowledged that, prior to the accident, Amtrak had been following the operating rules of the host. He said that on Amtrak property, during a signal suspension, trains were required to approach facing-point switches prepared to stop. He acknowledged that by following CSX rules, which allowed trains to proceed at track speed, risk had been increased. However, he indicated that Amtrak planned to address this issue.

The vice president stated that currently when Amtrak receives operating reports from host railroads such as signals suspensions or track outages that information is conveyed to "the

[31] The NTSB asked Amtrak to clarify its operating rules at the time of the accident and received several e-mails in response on April 23, 2019. According to Amtrak, on tracks it controlled: "There was not a written directive to approach a switch prepared to stop but non-signaled DCS rules [a Form D Control System] would require approaching signals prepared to stop." Additional details from Amtrak's response are provided in appendix B.

supervision of that territory," who would then "fill out a risk assessment." He said that the risk assessment will then be reviewed by the safety and operating group. He said that operating notices were then sent out to operating crews to implement whatever risk mitigations had been decided. He stated, "The most common mitigation that's been put in place since this process started was being prepared to stop at facing-point switches until it can be ascertained that the switch is lined for the intended movement."

The vice president further stated that Amtrak has had "a lot of dialogue with the hosts," and had a lot of success with the risk mitigations that they have implemented. However, he also said "We've had some areas where we've had pushback that the mitigation recommendation that's been put forth isn't agreed upon. So, there's going to be some cultural challenges as we pursue something new for the rail industry."

#### 1.15.1.3 Chief Safety Officer – Amtrak

Amtrak's chief safety officer was asked to compare the practices of Amtrak prior to and following the accident in Cayce. He said that, prior to the accident Amtrak "had just accepted the host railroad rules … without any real consideration." He said, "we started to ask ourselves, was that the best solution for the hundreds of passengers in the back of the train and our employees?"

The chief safety officer said that after the incident, Amtrak developed a methodology to coordinate with the operations control center to collect information, then implement a risk management process. He said that Amtrak management communicated to the organization that it expected changes to occur and continually sought evidence that the new process was being implemented. He said that Amtrak's resulting risk mitigation plans had always been accepted by the host railroads.

#### 1.15.1.4 President and Chief Executive Officer – Amtrak

Throughout his interview, Amtrak's CEO recounted his career, experiences, and positions held in the aviation industry, which began in 1987. He stated that while at Delta, he and others developed a "data-driven approach" to manage both operations and safety, as well as metrics, to track performance against regulatory compliance. He believed that the use of metrics drove operations to a safer level, and the use of quality assurance and forward-looking assessments helped identify where risks would be. He added that this approach was probably "the precursor to where SMS [safety management systems] is today." After becoming CEO of Delta in 2007, Delta merged with Northwest Airlines (NW), and he said that brought personnel and safety practices from NW to Delta that Delta was lacking.

He stated that the merger allowed for the introduction of SMS at Delta and that he supported a just culture, which meant the unfettered right of employees to stop unsafe operations without the risk of recrimination.

Upon arriving at Amtrak in November of 2017, and after receiving NTSB's report on the Train 89 accident in Chester, Pennsylvania, he and others began to implement SMS and movement toward a just culture. He added that the Train 501 accident in DuPont, Washington, on December 18, 2017, "accelerated" the implementation. The CEO noted that the formal roll-out occurred in

November 2018 when Amtrak officials met with FRA to review their system safety program plan (SSPP). He added that although many of the elements of their SMS were in place prior to the Cayce accident, one of the first applications came after that accident in which Amtrak reconsidered the risks of passenger train operations during a signal suspension on host railroads, and that led to the development of Amtrak's current signal suspension policy. (See section 1.17 in this report.)

The CEO agreed that Amtrak's implementation of an SMS is a "multi-year effort" to build a just culture and a downloadable database to measure and analyze risk. He provided an example of how Amtrak, through its SMS and conducting assessments, has rejected a request for "summer service" on a non-PTC territory, and he indicated that Amtrak has ceased operating special or "one-off" trains because they lacked personnel and because of the unfamiliarity with those territories. He also explained that Amtrak has focused on host railroads where PTC has not been implemented or met the regulatory deadline or may not be installed. He said that to date, Amtrak has assessed about 4,000 miles of non-PTC territory.

When asked about where he thought Amtrak was in terms of implementation of SMS at Amtrak, he replied, "we're probably about halfway to where we need to be" in terms of risk assessments (on Amtrak property). He estimated "late 2020" as a goal for "fully implemented on SMS," which is consistent with an Amtrak Board-approved 3-year plan.

The CEO was asked his thoughts about whether FRA's Part 270 [49 CFR Part 270], when exacted, would affect his vision of SMS, and he replied as follows:

> It's just that they [FRA] haven't made a decision yet on SMS, a final decision, and issued a final rule. My bet is, is they continue to defer it because there may not be wholesale agreement across all railroads that this is something that ought to be done.
>
> But we [Amtrak] don't have a choice. We followed their guidance in the NPRM [Notice of Proposed Rulemaking], and we just made sure it conformed over and above that. It gave what I would call a minimum standard of what had to be in the program. We covered that, but we're going above that, because we have a simulator plan, we have a data plan, you know, we have—just culture is a is a big, big change over and above anything that they have in their in their guidelines.

### 1.15.2 Host Railroad Relationship

Amtrak provided a document titled "Host Railroad Relationship," which summarized its host railroad relationships.[32] On page 2, the document states:

> Amtrak's operations on host railroads are primarily framed by statute, rather than arms-length economic transactions. Amtrak's statutory rights are derived from The Rail Passenger Service Act of 1970 and subsequent amendments, now codified 49 *U.S.C.* [*United States Code*] §§ 24101 et seq. These rights include:

[32] See "Exhibit-6: Amtrak Host Railroads" in the public docket, accessible by searching DCA18HR001.

- Access to any host rail line in the United States
- Use of host railroad facilities
- Payments based on host's incremental cost
- Amtrak preference over freight service

Amtrak's operating agreements with host railroads translate the general terms of the statute to host-specific negotiated terms and conditions that provide the foundation for day-to-day Amtrak operations on each host railroad, dealing with issues including:

- Operation of existing service
- Service standards
- Implementing new service
- Payment amounts and terms for services provided by the host
- Liability apportionment
- Dispute resolution

The document reveals that Amtrak has operating agreements with 29 host railroads for regularly scheduled services. Further, the agreements require annual updates of cost and schedule provisions, as well as periodic modification of access, liability, performance, and responsibility provisions. According to the document, Amtrak's Host Railroad Team serves as the primary liaison between all Amtrak departments and host railroads for issues related to network and service design, station services, and financial transactions governed by the host railroad operating agreements.

### 1.15.3 Host Railroad Agreement with CSX

Investigators received a copy of the host railroad agreement titled Agreement Between National Railroad Passenger Corporation and CSX Transportation Incorporated, dated June 1, 1999. According to the agreement, CSX supervises and controls the movement of all Amtrak trains on CSX rail lines, and Amtrak is governed by and subject to CSX operating rules. Section 3.7, CSX Control and Supervision (page 13) states the following:

> In the performance of services referred to in this Agreement, CSX shall have sole control of the operation of Amtrak's Intercity Rail Passenger Trains while on the Rail Lines of CSX. All personnel rendering any services which involve responsibility for CSX's operating facilities or for the handling or movement of any Intercity Rail Passenger Train shall be subject to the direction, supervision and control of CSX, and such services performed by or for Amtrak shall be governed by and subject to all then current operating and safety rules, orders, procedures and standards of CSX with respect thereto.[33]

[33] See "CSX Amtrak Agreement Redacted" in the public NTSB docket DCA18HR001.

### 1.15.4 Host Railroads Group

Information pertaining to operations on host railroads was discussed in two follow-up interviews. One interview with Amtrak's Host Railroads Group consisted of two interviewees, Amtrak's director of host railroads and senior director of host railroads. A second interview was with Amtrak's vice president of safety, compliance and training.

The Host Railroads Group indicated that the host railroad agreements generally mandate that Amtrak trains are subject to the rules and supervision of the host railroad. Investigators asked the group if it could clarify if safety is explicitly mentioned in the host railroad agreements. The director of host railroads responded, "I can't recall that it is."

The group was not aware of any instances in which a host railroad agreement facilitated an exchange of information about SMS. The senior director of host railroads believed that there were no provisions that would preclude Amtrak from requesting a different safety protocol than what the host would do on its own railroad. However, he did not know if Amtrak had ever made such a request.

Regarding Amtrak's internal communications, the director of host railroads stated that his team discussed issues with the operating departments frequently, and Amtrak's safety department would periodically seek information from him pertaining to the host railroad agreements. However, he indicated that communicating safety information was not a core responsibility of his team and stated that "very seldom are we engaged in safety-related communications."

### 1.15.5 NTSB Investigative Hearing

Following accidents in DuPont and Cayce, on July 10 and 11, 2018, the NTSB held an investigative hearing, *Managing Safety on Passenger Railroads*, where it addressed two Amtrak accidents involving host railroads. During the public hearing, which was held at NTSB headquarters in Washington, DC, officials addressed the February 4, 2018, Amtrak collision in Cayce, the December 18, 2017, derailment in DuPont, Washington, and the use of host railroads to operate most of the route miles of Amtrak services across the United States. Amtrak uses a Host Railroad Agreement to gain access to the host's right-of-way and to define the fee structure paid for such access. During the hearing, the Amtrak host railroads group said that the team rarely discussed safety issues and that it was unclear the extent to which safety provisions were contained in the host railroad agreements.

Several other topics were discussed pertaining to the Cayce accident during the hearing. The full transcripts from both days of the hearing are available in the public docket.[34]

#### 1.15.5.1 Host Railroad Agreements

The Amtrak director of host railroads indicated that the host railroad agreements were neither operating documents nor safety documents but rather commercial documents. He said that

[34] See NTSB public docket DCA18HR001 for "Rail Safety Hearing, 07-10-18, Redacted" and DCA18HR001 for "Rail Safety Hearing, 07-11-18 Redacted."

the agreements do not address efficiency testing, risk identification, risk mitigation, system safety, or operations during signal suspensions. The FRA operating practices specialist stated that the FRA does not regulate the terms of the host railroad agreements.

The Amtrak vice president, safety, compliance and training stated that when Amtrak train crews operate on host railroads they are governed by the operating rules and supervision of the host railroad. He stated that there is not a means for Amtrak to insist that certain safety practices be implemented on host railroads although Amtrak can "engage in a dialogue" with hosts and raise concerns.

#### 1.15.5.2 Risk Management on Host Railroads

The Amtrak vice president, safety, compliance and training stated that since the Cayce accident, Amtrak had developed and implemented a new signal suspension risk assessment approach. The approach, which he stated Amtrak has successfully deployed over 30 times, uses input from host railroads to identify hazards and then implements a suite of risk mitigations during signal suspensions. (See section 1.17.) For instance, he indicated that, "more often than not" Amtrak was applying operational mitigations such as reducing speed and approaching facing-point switches prepared to stop.

The vice president stated that there had been a challenge conducting such risk assessments on host railroads in the past but that there had been "dramatic" improvements in the "last several months," which he attributed to Amtrak "being more proactive soliciting feedback and input from the hosts." He said that in the past, risk assessments had been completed, but they "started and ended at the field level." He stated that risk assessments were now being performed across the entire system, on all host railroads, with managerial oversight, and mitigations were being implemented that mandated a more cautious approach than the standard operating practices of the host railroad. He added that, "We can no longer simply rely on the operating rulebook of a host and must instead augment our host operating practices in ways that meaningfully enhance safety of operations."

During the hearing, Amtrak's COO spoke about how Amtrak works with host railroads to assess and mitigate risk on host railroad lines. The COO indicated that he was "not an expert on host railroad processes, but certainly I am aware that if we've got concerns within the operating rules or the systems of the host, we would go through our Host Railroad Team." He suggested that the director of host railroads and his team would be the appropriate employees to "engage the host in conversation."

Investigators asked the COO about how Amtrak was using SMS principles to reduce risk during signal suspensions as compared to the methods Amtrak had used in the past. The COO referenced the statement given by the Amtrak vice president, safety, compliance and training earlier in the hearing. The COO added "what we do now is proactively look at the signal suspension, look at the data involved and make a decision on what we believe is the best way to proceed." He indicated that the new risk management approach is improving safety and Amtrak is now making "very good decisions."

## 1.16 CSX Operational Testing

Rules compliance ensures the safety of all employees and the public. Operational tests provide employees an opportunity to demonstrate their ability to apply rules and special instructions in the work environment. Operational tests set employee expectations in safety and operational rule compliance. The FRA requires that railroads check the employees for compliance with operating rules. Investigators requested and received a copy of 1-year operational testing records for two CSX trainmasters based out of the Cayce Yard as well as the conductor and engineer of the local train.[35] The conductor was efficiency tested 35 times from May 2017 to the day of the accident. The engineer was efficiency tested 59 times from January 2017 to the day of the accident. Neither the conductor nor the engineer was tested for operation of main track switches, or given a job briefing regarding position of main track switches, the use of EC-1 authority, or the SPAF. However, these crews stated that they only used EC-1s and the SPAF during events like the signal suspension or other signal outages.

### 1.16.1 Conductor Information

The CSX conductor's EC-1 forms show that between May 5, 2017, and February 3, 2018, the conductor worked in TWC territory 20 times. On six occasions the conductor worked in areas that involved the operation of main track switches. The conductor records did not show operational tests for the accident switch locations identified in CSX's timetable as S 367.0, S 367.4, and S 367.9. Table 4 shows the conductor's operational test on CSX operating rules pertaining to operating a switch, EC-1 authority, and SPAF that the conductor was tested or not tested on. (See appendix D in this report for a description of CSX switch operating rules.)

[35] A trainmaster oversees the safe departure and arrival of trains at a specific train terminal.

**Table 2.** Conductor's test on CSX operating rules.

| Switch Operating Rule | Number of Times Tested | Pass/Fail |
|---|---|---|
| 401.2: Lining switches and derails | 3 | Pass |
| 401.3: Confirming switch and derail positions | 2 | Pass |
| 401.4: Unlocking or operating switch or derail<br>401.5: Lining switch for diverging movement<br>401.6: Defective or missing switch or derail lock<br>401.7: Reporting defective or missing derail switch or derail lock | 0 | |
| 401.8: Actions to take after operating a switch or derail | 1 | Pass |
| 401.9: On main track, signaled track, or tracks, the normal position for hand operated switches is for movement on those tracks. | 0 | |
| 401.10: Hand operated switches | 0 | |
| 401.11: Normal position for derails | 0 | |
| 401.12: Line switches and derails for their designated normal position | 0 | |
| 401.13: Restore switches and derails on controlled tracks to their normal position before the movement is reported clear to the train dispatcher | 0 | |
| 401.14: Before departing a location where main track switches have been operated by hand, each crewmember must verbally confirm the position of the switches and that they have been locked. | 0 | |
| EC-1: Operating Rules 501 | 0 | |
| Switch Position Awareness Form | 0 | |
| 503.6: A train instructed to take track in TWC-D or TWC-ABS territory must report clear to the train dispatcher once the train has cleared the main track and switches have been restored for movement on the main track. | 0 | |

### 1.16.2 Engineer Information

Investigators reviewed CSX engineer operational testing records from May 5, 2017, through December 2, 2017. On December 1, 2017, a CSX official tested the engineer at the accident location (S 367) for the following operational rules:

- 407.1: Leaving equipment in the clear
- 406.2: Shoving equipment
- 406.1: Shoving equipment/being involved on unrelated tasks

Table 5 shows the CSX operating rules pertaining to handling a switch, application of EC-1 authority, and use of a SPAF that the engineer was tested or not tested on.

**Table 3.** Engineer's test on CSX operating rules.

| Switch Operating Rule | Number of Times Tested | Pass/Fail |
|---|---|---|
| 401.2: Lining switches and derails | 0 | |
| 401.3: Confirming switch and derail positions | 4 | Pass |
| 401.4: Unlocking or operating switch or derail<br>401.5: Lining switch for diverging movement<br>401.6: Defective or missing switch or derail lock<br>401.7: Reporting defective or missing derail switch or derail lock<br>401.8: Actions to take after operating a switch or derail | 0 | |
| 401.9: On main track, signaled track, or tracks the normal position for hand operated switches is for movement on those tracks. | 0 | |
| 401.10: Hand operated switches | 0 | |
| 401.11: Normal position for derails | 0 | |
| 401.12: Line switches and derails for their designated normal position. | 0 | |
| 401.13: Restore switches and derails on controlled tracks to their normal position before the movement is reported clear to the train dispatcher. | 0 | |
| 401.14: Before departing a location where main track switches have been operated by hand; each crewmember must verbally confirm the position of the switches and that they have been locked. | 0 | |
| EC-1: Operating Rule 501 | 0 | |
| Switch Position Awareness Form | 0 | |
| 503.6: A train instructed to take track in TWC-D or TWC–automatic block system territory must report clear to the train dispatcher once the train has cleared the main track and switches have been restored for movement on the main track. | 0 | |

### 1.16.3 CSX Trainmaster No. 1 Information

Investigators examined trainmaster No. 1's operational testing records from January 3, 2017, through December 28, 2017. The testing records numbers in table 6 are for all the employees under the trainmaster's supervision.

**Table 4.** Trainmaster No. 1's employees' testing records for CSX operating rules.

| Switch Operating Rule | Number of Times Tested | Pass/Fail |
|---|---|---|
| 401.1: Not operating switch or derail until qualified | 3 | Pass |
| 401.2: Lining switches and derails | 133 | Pass |
| 401.3: Confirming switch and derail positions | 149 | Pass |
| 401.4: Unlocking or operating switch or derail<br>401.5: Lining switch for diverging movement<br>401.6: Defective or missing switch or derail lock<br>401.7: Reporting defective or missing derail switch or derail lock | 0 | |
| 401.8: Actions to take after operating a switch or derail | 115 | Pass |
| **Switch Operating Rule** | **Number of Times Tested** | **Pass/Fail** |
| 401.9: On main track, signaled track, or tracks, the normal position for hand-operated switches is for movement on those tracks. | 0 | |
| 401.10: Hand operated switches | 0 | |
| 401.11: Normal position for derails | | |
| 401.12: Line switches and derails for their designated normal position | 0 | |
| 401.13 Restore switches and derails on controlled tracks to their normal position before the movement is reported clear to the train dispatcher | 0 | |
| 401.14: Before departing a location where main track switches have been operated by hand, each crewmember must verbally confirm the position of the switches and that they have been locked. | 0 | |
| EC-1: Operating Rule 501 | 0 | |
| Switch Position Awareness Form | 0 | |
| 503.6: A train instructed to take track in TWC-D or TWC-ABS territory must report clear to the train dispatcher once the train has cleared the main track and switches have been restored for movement on the main track. | 0 | |
| Test performed at the switches near the accident location | | |
| Test at S366.9 North end of Silica Storage | 0 | |
| Test at S367 South end of Silica Storage | 390 | Pass |
| Test at S367.4 North end of runaround track | 0 | |
| Test at S367.9 South end of runaround track | 0 | |

Investigators also examined the records to determine the number of operational test failures, dates of testing (frequency), and test results for trainmaster No.1 for the same period of time. Those results are reported in table 7.

**Table 5.** Trainmaster No. 1’s test on CSX operating rules.

| Rules Failures | Date | Event |
|---|---|---|
| 100.1: Know and comply with rules and instructions<br>GS13.2b: Riding equipment<br>GS13.17: Use seat belts when available | January 27, 2017 | 3 failed tests entered for the same employee |
| 405.5: After making a coupling, stretch slack to ensure couplers are locked. | May 23, 2017 | 1 failed test entered for one employee |
| 405.8: Moving equipment<br>408.1: Job briefings<br>408.2: Hand brakes in general<br>409.2: Applying hand brakes<br>409.4: Testing hand brakes | June 29, 2017 | 5 failures entered for one employee |
| 314.5: Shoving equipment at crossings | December 14, 2017 | 1 failed test entered for one employee |
| Total Test Entered of 2017 | 2,670 | |
| Total Test Comply (Pass) | 2,660 | |
| Total Test Fail | 10 | |

### 1.16.4 CSX Trainmaster No. 2 Information

Investigators examined trainmaster No. 2’s operational testing records from January 4, 2017, through December 28, 2017; the testing records numbers in table 8 are for all the employees under the trainmaster’s supervision.

**Table 6.** Trainmaster No. 2’s employees’ testing records for CSX operating rules.

| Switch Operating Rule | Number of Times Tested | Pass/Fail |
|---|---|---|
| 401.2: Lining switches and derails | 3 | Pass |
| 401.3: Confirming switch and derail positions | 2 | Pass |
| 401.4: Unlocking or operating switch or derail<br>401.5: Lining switch for diverging movement<br>401.6: Defective or missing switch or derail lock<br>401.7: Reporting defective or missing derail switch or derail lock | 0 | |
| 401.8: Actions to take after operating a switch or derail | 1 | Pass |
| 401.9: On main track, signaled track, or tracks, the normal position for hand operated switches is for movement on those. | 0 | |
| 401.10: Hand operated switches | 0 | |
| 401.11: Normal position for derails | 0 | |
| 401.12: Line switches and derails for their designated normal position. | 0 | |
| 401.13: Restore switches and derails on controlled tracks to their normal position before the movement is reported clear to the train dispatcher. | 0 | |
| 401.14: Before departing a location where main track switches have been operated by hand, each crewmember must verbally confirm the position of the switches and that they have been locked. | 0 | |
| EC-1: Operating Rule 501 | 0 | |
| Switch Position Awareness Form | 0 | |
| 503.6: A train instructed to take track in TWC-D or TWC-ABS territory must report clear to the train dispatcher once the train has cleared the main track and switches have been restored for movement on the main track. | 0 | |
| Tests performed at the switches near the accident location | | |
| Test at S366.9 North end of Silica Storage | 0 | |
| Test at S367 South end of Silica Storage | 286 | Pass |
| Test at S367.4 North end of runaround track | 0 | |
| Test at S367.9 South end of runaround track | 0 | |

Investigators also examined the records to determine the number of operational test failures, dates of testing (frequency), and test results for trainmaster No. 2 for the same period of time, which are shown in table 9.

**Table 7.** Trainmaster No. 2's test on CSX operating rules.

| Rules Failures | Date | Event |
|---|---|---|
| 5104: Determining rear car air pressure<br>5105: Determining application and release of rear car's air brake<br>5106: Restoring brake pipe pressure | 01/27/17 | 3 test failures entered for one employee |
| 409.6(1): Before cutting away from cars connected to air brake, make full-service brake reduction<br>408.1: Job briefings. | 02/01/17 | 2 test failures entered for one employee |
| 408.1: Job briefings<br>408.2: Hand brakes in general<br>409.4(a)/(b): Testing hand brakes | 02/16/17 | 8 test failures entered for a train crew of three |
| 100.1: Know and comply with rules and instructions<br>405.3: Safety stops before coupling<br>409.6(1)(2): Before cutting away from cars connected to air brake, make full-service air brake reduction | 03/08/17 | 4 tests failures entered for one employee |
| 100.1: Know and comply with rules and instructions<br>409.6(1): Before cutting away from cars connected to air brake, make full-service air brake reduction. | 06/07/17 | 3 test failures entered for one employee |
| 100.1: Know and comply with rules and instructions<br>401.8(5): Actions to take after operating a switch or derail | 06/28/17 | 2 test failures entered for one employee |
| 401.8(5): Actions to take after operating a switch or derail<br>408.1: Job briefings<br>408.2: Hand brakes in general<br>405.8: Moving equipment<br>409.2(c): Applying hand brakes<br>409.4: Testing hand brakes | 06/29/17 | 6 tests failures entered for one employee |
| 103.7(a): Employee conduct in general | 10/24/17 | 1 test failure entered for one employee |
| 401.3: Confirming switch and derail positions<br>100.1: Know and comply with rules and instructions | 11/17/17 | 2 test failures entered for one employee |
| 100.4: Possess personal copy of rule books, timetable, system bulletins, and division bulletins<br>108.1(a): Assignments requiring certifications and licenses<br>2009.8: Safety glasses<br>205.4(a): Rear locomotive headlight use | 12/14/17 | 4 test failures entered for a train crew of two |
| Total Test | 2,311 | |
| Total Test Comply | 2,277 | Pass |
| Total Fail Count | 34 | |

## 1.17 Postaccident Actions

### 1.17.1 Federal Railroad Administration

#### 1.17.1.1 Previous Recommendations to FRA

As a result of information obtained early in the Cayce investigation, on February 15, 2018, the NTSB issued the following Safety Recommendation R-18-5, an Urgent Recommendation, to the FRA:

> Issue an Emergency Order directing railroads to require that when signal suspensions are in effect and a switch has been reported relined for a main track, the next train or locomotive to pass the location must approach the switch location at restricted speed. After the switch position is verified, require the train crew to report to the dispatcher that the switch is correctly lined for the main track before trains are permitted to operate at maximum-authorized speed. (R-18-5) (Urgent)

In response to Safety Recommendation R-18-5, on April 23, 2018, the FRA published in the *Federal Register*, a notice of a draft safety advisory (SA) related to temporary signal suspensions. The notice discussed the FRA's intent to issue an SA addressing railroad operations under temporary signal suspensions. The SA would identify the existing industry best practices that railroads use when implementing operations under temporary signal suspensions. The SA would propose that railroads conducting rail operations under temporary signal suspensions develop and implement procedures and practices consistent with identified best practices. Additionally, the notice would recommend that railroads take certain other actions to ensure the safety of railroad operations during temporary signal suspensions. On November 20, 2018, the FRA published the SA in the *Federal Register* (*Federal Register* 2018, 58685). (See appendix E.)

On June 11, 2018, in comments submitted in response to the FRA's notice, the NTSB stated that although pleased that the FRA was proposing an SA recommending that all railroads adopt the industry best safety practices regarding railroad operations under temporary signal suspensions, an SA did not require railroads to adopt the industry best practices. In its comments, the NTSB also discussed several parts of the notice that appeared to offer contradictory statements. Recommendation 6 in the notice stated that railroads should "encourage employees, in case of any doubt or uncertainty regarding the position of such switches, to immediately contact the train dispatcher or take other appropriate action to confirm the position of the switch prior to authorizing a train to operate through the limits of the area." However, the NTSB noted that using a switch tender or switch position awareness form has been shown in NTSB investigations to be ineffective in preventing accidents. Although it concurred with the FRA's assertion that best procedures and practices should be implemented, in its June 11, 2018, comments, the NTSB did not agree that an advisory goes far enough to ensure safety. The NTSB believed that the FRA should mandate that, if any switches within suspension limits are manipulated, railroads must establish an effective means of verifying that all switches have been returned to the proper position prior to any train traffic operating through the limits. The NTSB stated that regulatory mandates to ensure trains operate safely during temporary signal suspensions were needed. Pending strengthening the proposed advisory and converting it into a rule, Safety Recommendation R-18-5 was classified *Open—Unacceptable Response.*

### 1.17.2 Amtrak

On March 4, 2018, Amtrak issued a new system operating rule (instruction) to address train movement through signal suspension limits on host railroads. A summary of the rule follows.

> To ensure passenger train safety, in addition to complying with all host railroad operating rules and special instructions during planned signal suspensions, train crews of Amtrak trains operating in territory with a planned signal suspension where Positive Train Control (PTC), Cab Signals and wayside block signal systems are not in service must perform the following tasks:
>
> - Trains will operate at restricted speed within the limits of the signal suspension.
> - Crews must conduct job briefing to identify any facing-point switches.
> - Conductor must remind the engineer of the approach to the signal suspension no less than 2 miles beforehand.
> - Train must not pass over facing-point switches until the engineer or conductor visually determines that the switches are properly lined.
> - If switches are improperly lined, crews must stop the train and notify the dispatcher immediately.

### 1.17.3 CSX Transportation

On March 7, 2018, CSX issued a subsystem bulletin on changes on Operating Rules 401.14,505.11 and 505.12. CSX Subsystem Bulletin 019 contains the following instructions pertaining to operations during a signal suspension, which reads in part as follows: (See appendix D for full text.)

> Employees releasing authority after using hand-throw switches must:
>
> - Remain at the switch and confirm with crewmembers that the switch has been restored to normal.
> - Have SPAF completed in ink.
> - Retain the SPAF.
> - Prior to releasing switch authority, crewmembers must agree it is safe for operations.
> - If switch position is in doubt, the authority must not be released; or if doubt arises after releasing authority, the crew must immediately contact the dispatcher with SPAF details.

Additionally, in response to the FRA's SA, CSX developed a plan whereby "the Signal Department will continue to provide sufficient resources to minimize a Signal Suspension's duration and the number of control points affected." CSX's new procedure for securing switches is summarized here as follows:

- Signal Department personnel places all power switches on hand-throw.
- All switches are secured with a Signal Department lock and red tag.
- Before trains operate through the suspension, signal personnel notify the dispatcher of the position of each switch.
- When the cutover is complete, signal personnel restores power to power switches and, for all switches, replaces their lock with a transportation switch lock.
- If a switch must be operated during a Signal Suspension, it must be authorized by the dispatcher. In that event—
    - Operating personnel notifies signal personnel to unlock the switch;
    - Once the switch is lined reversed, the signal personnel verifies and secures it is locked; and
    - Train crew will not pass the location until contacting the switch tender.
    - After the train movement, the train crew or switch tender restores the switch and signal personnel secures it. The train crew or the switch tender notifies dispatcher of switch restoration and securement and relays the SPAF details.

With CSX's operational changes in place, the CSX Signal Department issued its CSX Signal Suspension Operating Plan, which provides instructions for how signal personnel employees are to perform work during a signal suspension. The new instructions cover job briefings, oversight, adequate staffing, operations center, and train crew responsibilities and communication. CSX concluded the following: The operating plan as outlined above creates additional safety measures for signal suspensions. In addition to existing rules governing the use of hand-operated switches, this plan incorporates the best practices outlined in the FRA SA and provides redundant verification of switch position.

# 2 Analysis

## 2.1 Exclusions

Investigators examined the records for weather, track, equipment, and signal inspections and maintenance. The track structure and passenger and freight equipment were inspected and maintained within regulatory standards. A review of cell phone records showed that there was no cell phone usage by the Amtrak crew, and the CSX crew only used a cell phone to notify dispatch of the accident. A review of hours of service records indicated that both crews had received the required off-duty time prior to their reporting for duty.

Amtrak train P91 departed Columbia, South Carolina, about 2:01 a.m. and stopped at a red signal at MP S 362.5 to get authority to pass a stop indication to enter the limits of the signal suspension. Amtrak train P91 waited for about 10 minutes before the train dispatcher answered the radio and authorized Amtrak train P91 to pass the stop indication, and the train continued southbound. The assistant conductor said that once they had copied the EC-1 and received authority to pass the stop signal at MP S 362.5 they began operating south again.

Based on crew interview records and event recorder data throughout the trip, the Amtrak crew complied with Amtrak and CSX rules and FRA regulations. The crew was familiar with the territory and was up to date on training and territory qualifications. The NTSB concludes that none of the following was a factor in this accident: the mechanical readiness of the train or the condition of the track.

Both the CSX locomotive engineer and conductor had work schedules with minimal variability in the shift start times in the days leading up to the accident. That is, they consistently started their shifts at 3:30 p.m. Moreover, no medications or sleep disorders were identified that could contribute to fatigue. (See section 2.2.) Although the CSX conductor made an error late in the evening after working more than 10 hours, a time when people typically are approaching a circadian low and alertness levels are at their lowest, there was no evidence that his performance was affected by fatigue. He told investigators that he was not experiencing fatigue during his shift and that he had obtained enough rest in the days preceding the accident. However, he was performing repetitive physical labor outside, in the cold, and he said that he had gotten into a work rhythm. Because of the presence of evidence mitigating both for and against the presence of fatigue, it could not be determined whether fatigue contributed to the circumstances of the accident.

## 2.2 Medical

### 2.2.1 Crewmembers

The Amtrak conductor was found to have a low level of diphenhydramine, a sedating antihistamine, in his blood postmortem. However, the specimen tested was heart blood (a central source). Because diphenhydramine undergoes postmortem redistribution with a ratio as high as three between peripheral and central blood, his actual level at the time of the accident was likely below the level believed to cause any effects. Therefore, it is unlikely any impairing effects from the Amtrak conductor's use of diphenhydramine contributed to the accident.

The Amtrak engineer was documented to generally have good control of his diabetes and high cholesterol. Records demonstrated good to fair control of his glucose and no recent episodes of low blood sugar.[36]

The NTSB concludes that no medical condition or use of any medication by the Amtrak crew contributed to the circumstances of the accident.

The CSX conductor did not have any identified medical conditions in his limited CSX occupational medical record at the time of the accident, and the FRA postaccident toxicology tests were negative.[37] The CSX engineer had reported treatment for high blood pressure when returning to work following foot surgery in 2010, but no comprehensive health evaluations or blood pressure measurements were available in his CSX occupational medical record. His FRA postaccident toxicology testing was negative, but neither CSX train crewmember underwent the more comprehensive toxicology testing performed on the Amtrak crew.[38] The NTSB concludes that due to the limited available medical information for the CSX train crew, it could not be determined whether any medical condition or use of medication contributed to the circumstances of the accident.

### 2.2.2 Passenger Injury Mitigation – Occupant Protection

Overall, 90 of the 149 (60.4 percent) occupants of Amtrak train P91 were injured in this accident.[39] Both crewmembers on the locomotive died. Those ticketed in coach seats were more likely to seek immediate medical attention than those in roomettes or bedrooms (about 80 percent of those in coach seats were injured). None of the passengers ticketed in roomettes or bedrooms was seriously injured (about 17 percent were injured), but one seriously injured crewmember reported being thrown from an upper bunk. According to many passenger reports documented in the medical records, the seated occupants were thrown out of their seats during the crash sequence. The majority of injuries (lacerations and contusions) were to the face, head, and knees, or shins. Two people had broken teeth, one had a broken nose, and one had a facial fracture. Of those seriously injured, three reported falling against the edge of a table, and one reported falling out of an upper bunk.

In this accident, the occupants experienced primarily forward motion as the train derailed and came to a standstill. All of the cars remained upright, and there was relatively little damage to the passenger cars themselves. Still, the majority of train car occupants were injured, eight of them seriously. At least three of those seriously injured struck the edges of tables. The majority of the

[36] Uncontrolled blood sugar levels can lead to short-term problems like hypoglycemia, hyperglycemia, or diabetic ketoacidosis, which may cause fatigue, anxiety, irritability, confusion, abnormal behavior such as the inability to perform routine tasks, seizures, or loss of consciousness.

[37] FRA obtains both blood and urine specimens, and if the urine is negative FRA discards the blood. It is not tested nor made available for NTSB to test.

[38] By law, the NTSB may not directly obtain specimens from surviving vehicle operators in accidents it investigates.

[39] Three of the people transported to the hospital were not diagnosed with any injury.

injured were those ticketed in coach seats rather than in roomettes or bedrooms; although "compartmentalized," they were thrown forward against the structures in front of them with enough force to cause significant head and facial injuries. The NTSB concludes that the majority of passenger injuries resulted from the passengers being thrown from their seats when the trains collided and derailed.

Title 49 *CFR* Part 238 contains the current safety requirements for passenger railroad equipment. Those regulations include standards intended to minimize the effects of collision crash forces by trying to ensure that occupant space is preserved (structural crashworthiness) and that interior fittings such as seats remain secure (interior crashworthiness). To study these standards, the FRA has sponsored full-scale collision testing with conventional and crash energy management equipment (FRA 2002, 2003, 2009). This research for passenger car crashworthiness has focused on in-line collision scenarios and the occupant response to the initial collision impact. In this accident, the passenger cars largely met the objectives of preserved space and secure seats. However, this was not enough to prevent significant injuries and indicates that the effects of derailments on passenger safety have not been sufficiently addressed.

Passenger equipment safety regulations did not exist prior to 1999, and the NTSB acknowledges the progress in passenger car design that has been made in the past two decades. These safety standards, however, should not remain static because they may not provide sufficient protection to prevent injuries to occupants in survivable derailments such as this one.

The NTSB notes that in the case of highway vehicles, occupant protection standards have evolved to reflect current knowledge of crash dynamics. For example, the NTSB has recognized that in the case of school buses, compartmentalization is an incomplete solution, and seat belts provide an additional layer of injury prevention, especially in lateral impacts and rollovers (NTSB 2013).[40] In commercial aviation, energy-absorbing seats and collapsing seat backs are required to meet safety standards. The effectiveness of aviation occupant protection standards has been demonstrated by the fact that over the last decade only one belted passenger was fatally injured in an airline crash in the United States.

Therefore, the NTSB concludes that although the passenger equipment safety standards in Title 49 CFR Part 238 provide some level of protection for occupants, the current requirements are not adequate.

The NTSB came to a similar conclusion following its investigation of the derailment of Amtrak train 188 in Philadelphia in 2015 (NTSB 2016). As a result of the Philadelphia accident, the NTSB issued two recommendations to the FRA addressing improvements needed to the FRA's occupant protection standards.

> Conduct research to evaluate the causes of passenger injuries in passenger railcar derailments and overturns and evaluate potential methods for mitigating those injuries, such as installing seat belts in railcars and securing potential projectiles. (R-16-35)

[40] Compartmentalization in school buses is the concept of using tall seat backs padded with energy-absorbing materials with relatively close spacing to protect occupants in forward collisions. This is not used in rail cars.

> When the research specified in Safety Recommendation R-16-35 identifies safety improvements, use the findings to develop occupant protection standards for passenger railcars that will mitigate passenger injuries likely to occur during derailments and overturns. (R-16-36)

The FRA responded to these recommendations in a letter on August 23, 2017, indicating that through its RSAC Passenger Safety Working Group (PSWG), it had continually supported numerous research activities evaluating the causes of passenger injuries in various train derailment and collision scenarios. The FRA went on to say it believed that, unlike accidents in the automobile and air transportation modes, adding seat belts in passenger cars was not an effective way to increase safety because the purpose of seat belts was to allow occupants to survive the deceleration of the vehicle they are in. According to the FRA, passenger rail coach peak deceleration is one-fourth that of automobiles during a collision, and therefore the interior of a typical passenger rail coach provides a level of protection to passengers, at least as effective as the protection provided to automobile and air transport passengers, without the need for seat belts.

In addition, the FRA stated that it had extensively evaluated the effectiveness and practicality of available occupant protections, such as seat belts, and concluded that focusing efforts on passenger containment and interior attachment integrity and ensuring that passengers survive secondary impacts were the most effective methods of preventing and mitigating passenger injuries. The FRA indicated that it would continue to support and perform research to evaluate the causes of passenger injuries in train derailments and collisions as specific issues arise, but it did not plan to initiate a separate new research program.

Finally, in the same letter, the FRA went on to assert that "the interior of a typical passenger rail coach can provide a level of protection to passengers, without active restraints, at least as effective in preventing fatality as the protection provided to automobile and air transport passengers." In the Cayce collision, the available level of protection did prevent fatalities from occurring in the passenger coaches but did not prevent serious injuries or mitigate significant "minor" injuries, particularly to passengers' faces. Required design and operational standards in passenger airplanes, such as collapsible seat backs that limit potential head injuries, minimize the risk of these injuries in an airplane that comes to a sudden stop in a low-velocity incident while landing. The NTSB believes preventing fatalities is not the only goal of occupant protection, and potential solutions are not limited to restraints.

The NTSB found similar issues in the investigation of the accident in DuPont, Washington. In that report, Safety Recommendations R-16-35 and -36 were reiterated and classified *Open—Unacceptable Response.* The injuries in the Cayce accident further demonstrate the need for improved occupant protection in rail, and as a result the NTSB reiterates Safety Recommendations R-16-35 and R-16-36.

## 2.3 Operations During a Signal Suspension

Periodically, railroad employees are tested on various aspects of their job to evaluate their ability to perform their jobs correctly and their knowledge of company rules and the FRA regulations (49 CFR Part 217). This testing not only evaluates the worker's skills and overall ability to perform a task safely and correctly, but it also reinforces compliance with rules. The

NTSB acknowledges that if workers expect to be observed and evaluated, they are more likely to follow rules and best practices.

The CSX engineer and conductor were jointly responsible for the normal position (lined for main track movement) of the main track switch as required by CSX Operating Rule 401.14 and 49 CFR 218.108. The engineer stated that he had asked the conductor several times if he had restored the main track switch for main track movement, but that conversation occurred after the conductor had released their EC-1 authority to the dispatcher. The purpose of the job briefing in accordance with CSX Operating Rule 401.14 and 49 CFR 218.105 is to ensure that the main track switch is properly lined for main track movement prior to releasing track authority. According to the engineer, he questioned the conductor on the position of the main track switch several times after both of them had sat in the locomotive cab 10 to 15 minutes; therefore, he should have had the conductor verify the position of the switch, and both of them should have immediately contacted the dispatcher to advise him that they would need to verify the switch position. However, the conductor released the track authority to the CSX train dispatcher at 1:51 a.m., and the collision occurred at 2:27 a.m.

The train crew performed switching operations for almost 6 hours before releasing the EC-1 authority. The conductor, while performing switching operations, released and applied hand brakes and lined multiple switches multiple times. Since the auto rack cars were not equipped with platforms and the conductor was on the ground by himself, he had to walk the length of the tracks and around the auto racks to get to the opposite side to apply and release hand brakes.

At the end of their shift, the engineer and conductor had a job briefing between themselves on the position of the main track switch but were not in full agreement on the position of the switch. It was only after the release of the train crew’s EC-1 authority, the conductor was asked by the train dispatcher if the main track switches were lined for normal movement (main track). The conductor erroneously reported to the train dispatcher that all main track switches were lined for the main track.

The job briefing, as required by CSX operating rule and FRA regulation, was ineffective in verifying the position of the switch. NTSB’s investigation showed that the main track switch was not equipped with a reflective target or switch position lights, which were not required. The conductor notified the CSX train dispatcher that the main track switch at MP S 366.9 was placed in the normal position at 8:15 p.m. and that the track authority release time was 1:51 a.m. These times were inconsistent because the release time was 5 hours 35 minutes after he said he last threw the switch reverse, and this does not agree with the duration of time spent switching the auto ramp facility. Use of the SPAF failed to ensure that the main track switch was lined for normal movement. In addition, a review of the CSX train dispatcher instructions allowed for an additional crewmember (switch tender); however, a third train crewmember (switch tender) was not assigned. The NTSB concludes that the two-person train crew performing switching that required the use of main track switches would have benefited from an additional train crewmember assisting with the operation of the main track switches because, in this unique situation the signal system did not provide a second level of safety for the operation of the main track switch.

A signal suspension changes the environment in which the train crews operate. During a signal suspension, the train crews must adapt to operating rules that apply to non-signal territory, and crews may not have recently applied these rules. In signal suspensions, signal aspects may appear red, dark (unlit), green, yellow, or flashing yellow to an approaching train, yet the indications they convey are to be disregarded. Communication between the train crews and the train dispatcher is critical as redundant levels of protection with a misaligned switch (signal displays red aspect, or dispatcher can monitor track indications) is lost. Therefore, CSX should have made a risk assessment to mitigate the potential risk where the operating rules and procedures may not have worked as intended. A risk assessment may have demonstrated the need for additional layers of safety checks such as additional supervisors or train crew efficiency testing. There was an added layer of risk when CSX allowed the accident train crew to perform switch operations in an already changed operational environment. The NTSB concludes that the CSX train crew performed switching operations in the accident area for about 6 hours in a changed operating environment of a signal suspension without sufficient planning, a risk assessment, and the implementation of appropriate risk mitigations.

Planning for the signal suspension involved setting the date and time and limits of the suspension. The primary focus was to allow for both time to perform testing of the signals and the safety of signal personnel. The operating train crews were expected to adapt to the changed environment. CSX told the NTSB investigators that any challenges encountered by crews during a signal suspension are "pretty much covered by the operating rules." The NTSB concludes that the changed environment of a signal suspension not only challenges the movement of trains and operating crews but also limits the effectiveness of the operating rules and regulations.

As part of their responsibilities, CSX trainmasters in Cayce, South Carolina, were required to test operating crews on switching operations such as inspection of switch points, protecting shoving movements, securing equipment to prevent it from rolling out of a track, and stopping short of a banner.[41] The operations testing records for the trainmaster revealed that they did not conduct these tests for the operation of main track switches, SPAF, or EC-1 authority. The CSX accident train crewmembers operational testing records revealed they had not been tested on using EC-1 authority operation of main track switches or effective use of SPAFs nor had they received any refresher training.

The testing records also noted failures by both crewmembers, primarily on securing equipment. There were no test results entered on any crewmembers for the operation of main track switch, EC-1 authority, or SPAF. No tests were entered for any crewmembers on the operating rules pertaining to train movement on the main track. Due to the infrequent use of the EC-1 and the SPAF, the crew should have had refresher training or have been tested. The NTSB concludes that the CSX crew efficiency tests for the operation of main track switches, EC-1 authority, or the SPAF failed to ensure safety.

In postaccident actions, CSX conducted safety operations testing that included efficiency testing of the train crews for EC-1 authority, job briefings on position of main track switches (including electronically locked) in non-signaled territory (dark territory), and SPAF. Managers conducted efficiency tests on train crews operating in a signal suspension.

[41] A *banner* is a temporary sign, depicting an obstruction, that is placed on the track by a railroad manager to test an approaching train for compliance with the restricted speed.

## 2.4 Human Performance

### 2.4.1 Errors of Omission

The CSX conductor's failure to realign a hand-operated switch located at the north end of Silica Storage track resulted in the collision. The CSX conductor stated that he was alert, clearheaded, focused, and not distracted from his work while on duty. He also stated that, prior to the collision, he felt confident that he had correctly lined the switch. However, after thinking about the incident, he acknowledged that he overlooked realigning the switch. From his interview, the conductor presented his oversight with clarity, indicating that he had no intention to deliberately leave the switch misaligned. The conductor appeared distressed about the accident and about his role in it.

The NTSB has investigated similar accidents in Graniteville, South Carolina (NTSB 2005) and Roswell, New Mexico (NTSB 2018). In those investigations, it was determined that errors had occurred as a result of actions not taken—that is, errors of omission.

Dr. James Reason, a psychologist specializing in the study of human error, has professed that "the failure to carry out necessary steps in the performance of a task is probably the single most common human error type" (Reason 1998). Reason has identified several features that increase the probability that a particular step in a task will be omitted. Several of these likely contributed to the conductor's failure to realign the switch.

1. Recursive or repeated procedural steps are particularly prone to omission. In the case where two similar steps are required to achieve a particular goal, it is the second of these two steps that is most likely to be neglected.

Data from the NTSB Event Recorders Report show that between about 9:00 p.m. on February 3, 2018, and the collision at about 2:27 a.m. on February 4, 2018, the locomotive made approximately 120 forward and backward movements near MP S 367.7.[42] This is consistent with the crew performing many switching movements. Moreover, in his interview, the CSX conductor recalled thinking "there's more switching than I thought." Thus, the switching operations performed by the CSX crew on the night of the accident were repetitive because the crew had performed many similar steps throughout the night.

Near the end of the shift, the CSX conductor recalled that there were two switches that he needed to realign at about the same time—the North End Silica Storage switch, and another switch for the runaround track. Thus, there were two similar steps that needed to be completed. The conductor realigned the runaround switch but neglected the North End Silica Storage switch.

2. Necessary steps that follow the achievement of the main goal of a task are likely to be omitted. This is an instance of a general principle: Steps located near the end of a task sequence are more prone to omission.

[42] See report RRD18MR003, "Event Recorders Report_Final-Rel." in the NTSB public docket.

The main goal of the CSX crew was to finish its switching operations. This objective was realized once the last car had been placed. The step of realigning the switches was essentially a “clean up” task, that, though critical, was not required to complete the main goal (to place the last car). When the conductor called the dispatcher to release track authority, he had already moved on to the next step in the process. In his mind, the work was completed for the night, and he only needed to wait for a ride home.

3. Steps in which the item to be acted upon is concealed or lacking in conspicuity are liable to omission.

There was no switch banner, switch-position signal, or visual indicator extending vertically from the switch that would increase the visibility of the switch setting, and there were no sources of illumination other than natural ambient light to aid an observer in seeing the switch position. Moreover, the accident occurred at about 2:27 a.m., and it was dark. Thus, the dark ambient illumination level around the switch decreased the probability that the conductor’s attention would have been directed toward it.

4. Tasks that involve planned departures from standard operating procedures or from habitual action sequences are liable to strong habit intrusions in which the currently intended actions are supplanted by a more frequently used routine in that context, and thus omitted.

The CSX conductor had performed the job that he was engaged in on the day of the accident about five or six times in the prior year. He said that every time he had performed the job, the signal system had been operational and the SPAF was not required. On the day of the accident, the signal system was suspended, and a SPAF was required. The evidence suggests that this departure from the conductor’s experience with the job may have contributed to his failure to record the switch realignment times as he was operating the switches. (The conductor stated that switch realign times were later written on the SPAF, but these times were not meaningful.)

In addition, it is likely that the CSX conductor’s intended actions with respect to the realignment of the North End Silica Storage switch were supplanted by a more frequently used routine in that context. That is, after completing the final switching movement of the shift, the conductor had intended to remain at the switch and realign it. However, it is likely that he inadvertently engaged in the more frequently used work routine of riding the locomotive back, leaving the switch lined to the track.

Human errors are inevitable and predictable. Researchers have identified several task properties that increase the likelihood of errors of omission, at least four of which were present in the Cayce accident. At the time of the collision, the CSX conductor was under the impression that he had successfully realigned all the switches, and it was only later, after thinking about the incident that he realized he had made a mistake. The NTSB concludes that the CSX conductor’s failure to realign the North End Silica Storage switch was an error of omission.

The CSX crew told investigators that they completed a SPAF but had input inaccurate switch realignment times. The CSX conductor reported switch realignment times of 8:49 p.m. and 10:10 p.m. to the dispatcher in a conversation that he concluded by releasing his track authority at 1:51 a.m. The reported times were clearly inaccurate because it would not be logical for the crew to complete their work more than 3 hours before calling the dispatcher to release track authority. The dispatcher took no exception to the highly suspicious switch realignment times provided to him. The NTSB believes that the CSX dispatcher missed an opportunity to verify that the times reported to him from the SPAF were accurate even though the information reported to him was clearly inaccurate.

The SPAF requirement is an administrative control. Administrative controls alter the way the work is done, including the timing of work, policies and other rules, and work practices such as standards and operating procedures.[43] According to the National Institute for Occupational Safety and Health (NIOSH):

> Administrative controls and PPE [personal protective equipment] are frequently used with existing processes where hazards are not particularly well controlled. Administrative controls and PPE programs may be relatively inexpensive to establish but, over the long term, can be very costly to sustain. These methods for protecting workers have also proven to be less effective than other measures, requiring significant effort by the affected workers.[44]

NIOSH describes a hierarchy of controls. The most effective control is elimination, followed by substitution, engineering controls, administrative controls, and PPE. Thus, administrative controls are among the least effective controls.

The available evidence suggests that CSX failed to properly address the risks associated with operating during a signal suspension. CSX should have assessed the risk of conducting switching operations at night, with the signals suspended, and the need to route a passenger train through the area. If they had, they likely would have realized that risk was significantly increased, and weak administrative controls (the SPAF) were insufficient. The NTSB concludes that the SPAF is an ineffective control that did not mitigate the risk of an improperly lined switch.

Additionally, there was no lighting around the switch that the conductor forgot to realign. If the signals had been active, this would not have been an issue because the dispatcher would not have been able to allow a train through the area with the switch left open. However, with the signals suspended, the burden to ensure that the switch was realigned was left to the crew. Because CSX did not ensure that there was any lighting at the switch, the only way to verify that it was realigned was for the crew to physically walk over to it and use their flashlights.

The only risk mitigation CSX used was additional procedures, including the SPAF. The CSX conductor, engineer, and dispatcher all failed to ensure that the SPAF was properly completed. The FRA has already established that the SPAF is not effective and removed it as a requirement. Thus, the NTSB concludes that CSX failed to properly assess and mitigate the risk associated with conducting switching operations with the signals suspended.

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[43] See https://www.ccohs.ca/oshanswers/hsprograms/hazard_control.html.

[44] For a discussion of the Hierarchy of Controls, see the National Institute for Occupational Safety and Health website, https://www.cdc.gov/niosh/topics/hierarchy/.

## 2.5 Federal Railroad Administration Mitigation of Misaligned Switch Risk

It is evident from the current accident and others, such as those that occurred in Graniteville, South Carolina; Shepard, Texas; Bettendorf, Iowa; Granger, Wyoming; and Roswell, New Mexico (NTSB 2005, 2006, 2012, 2017d, 2018) that switching operations can involve situational factors that increase the probability that humans will commit errors that result in catastrophic accidents. The NTSB has been concerned about misaligned switches since at least 1974, when it investigated a fatal accident in Cotulla, Texas, involving a misaligned switch in non-signaled territory (NTSB 1974). Thus, the NTSB has been investigating and making recommendations to prevent misaligned switch accidents for more than four decades.

According to data obtained from the FRA's website, improperly lined switches were the leading cause of accidents/incidents (not at grade crossings) in 2017.[45] Moreover, further analysis by NTSB staff revealed that during the 5-year period between 2013 and 2018, there was one person who died and 65 people injured as a result of accidents where "Use of Switches" was coded as a primary or contributing cause.[46]

Safety Recommendation R-18-5 was an urgent recommendation to the FRA to require that when signal suspensions are in effect and a switch has been reported relined for a main track, the next train or locomotive to pass the location must approach the switch location at restricted speed. As discussed in section 1.17.1.1 of this report, on April 23, 2018, the FRA published in the *Federal Register*, a notice of a draft SA related to temporary signal suspensions. On June 11, 2018, in comments submitted in response to the FRA's notice, the NTSB stated that although pleased that the FRA was proposing an SA recommending that all railroads adopt the industry best safety practices regarding railroad operations under temporary signal suspensions, an SA did not *require* railroads to adopt the industry best practices. The NTSB noted that using a switch tender or SPAF has been shown in NTSB investigations to be ineffective in preventing accidents. The NTSB does not agree that an advisory goes far enough to ensure safety and that the FRA should mandate that, if any switches within suspension limits are manipulated, railroads must establish an effective means of verifying that all switches have been returned to the proper position prior to any train traffic operating through the limits. Pending strengthening the proposed advisory and converting it into a rule, Safety Recommendation R-18-5 was classified *Open—Unacceptable Response*.

On November 20, 2018, the FRA issued the SA related to temporary signal suspensions, but it does not adequately address issues discussed in the NTSB's June 11, 2018, comments. On March 14, 2019, the FRA again wrote to the NTSB noting that on March 8, 2018, the FRA and the NTSB met and discussed this recommendation. The FRA said that it was considering the recommendation to determine what measures are necessary to ensure safety when railroads temporarily suspend signal systems to implement PTC technology. Once the FRA has made that

[45] Train Accidents and Rates, published by the FRA Office of Safety Data. (http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/Query/TrainAccidentsFYCYWithRates.aspx), accessed March 8, 2018. Variable name "H702 Switch improperly lined."

[46] See "Data Report – Accidents Caused by 'Use of Switch' Codes 2013-2017," in the public docket DCA18HR001 for this accident.

determination and decided whether additional action is necessary, the FRA would inform the NTSB of its planned action.

Safety Recommendation R-18-5 was issued as an urgent recommendation, indicating that the recommended action required immediate attention to avoid imminent loss due to a similar accident. Urgent recommendations should be implemented within 1 year. More than a year after Safety Recommendation R-18-5 was issued, the FRA is still considering whether to take the needed action. Consequently, Safety Recommendation R-18-5 is classified *Closed—Unacceptable Action*.

As a result of the investigation of the accident in Roswell, New Mexico, the NTSB issued Safety Recommendation R-18-10 to the FRA to address the risk associated, in part, with misaligned switches. On August 24, 2018, the FRA replied that it does not believe the technology to address the recommendation currently exists and that developing this technology requires time-consuming, costly research and development, with decreasing benefits as PTC is implemented. The FRA believes that implementing this recommendation would require technological redundancy to existing governmental regulations and railroads' operating rules, increasing costs while providing minimal benefits. Because the technology required is not currently available, and there are no efforts to create it, the FRA did not plan to take the recommended action. The FRA continues to insist that the NTSB's recommendations would be too costly, and in the past has only mandated weak administrative controls such as the SPAF and job briefing requirements. Such controls amount to minor rule changes for those operating in direct contact with the system. As discussed by the NTSB after the Graniteville accident and above in the current accident, the critical errors of omission did not occur due to a lack of rules. Unless the FRA implements more robust safety interventions, misaligned switch accidents will continue to occur. The NTSB concludes that the FRA has failed to implement effective regulation to mitigate the risk of misaligned switch accidents. Therefore, the NTSB classifies Safety Recommendation R-18-10 *Open—Unacceptable Response* and reiterates Safety Recommendation R-18-10 to the Federal Railroad Administration as follows:

> Require railroads to develop a device or technique to eliminate the possibility of employees failing to perform critical tasks such as lining a switch, lining a derail, or ensuring cars are in the clear. (R-18-10)

Pending action by the FRA, the NTSB believes that CSX would benefit from implementing safety recommendation R-18-10 in its system. Therefore, the NTSB recommends that CSX develop a device or technique to eliminate the possibility of employees failing to perform critical tasks such as lining a switch, lining a derail, or ensuring cars are clear of the main track.

## 2.6 Amtrak Safety Management on Host Railroads

Amtrak operates on track that it owns, as well as track that it does not own—referred to as a host railroad. Amtrak maintains host railroad agreements to access the infrastructure necessary to provide nationwide passenger rail service. The host railroad agreement between Amtrak and CSX, for instance, allows Amtrak to operate on rail lines on the eastern side of the United States that it would otherwise be unable to access. Hence, when a person purchases an Amtrak ticket to travel from the east coast to the west coast, they will be riding in an Amtrak train, but they will travel on various rail lines owned, operated, and maintained by other organizations.

### 2.6.1 Amtrak System Safety Program Plan

Whereas SMS is a formal, top-down, organization-wide approach to managing safety risk and assuring the effectiveness of safety risk controls, an SSPP is a document that describes in detail the tasks and activities of the SMS.[47] An organization's SSPP is important because it articulates a plan to manage safety. While the written plan alone will not improve safety, it provides guidance to the organization by defining critical safety processes—such as managing risk and conducting safety audits.

After a fatal Amtrak accident occurred in Chester, Pennsylvania, on April 3, 2016, the NTSB recommended that Amtrak develop and implement an SMS (R-17-26 and R-17-27) (NTSB 2017b). Safety Recommendation R-17-26 asked Amtrak to work collaboratively with labor in an effort to develop a comprehensive SMS program that complies with pending FRA regulation in 49 CFR Part 270, System Safety Program, and that vitalizes safety goals and programs with executive management accountability; incorporates risk management controls for all operations affecting employees, contractors, and the traveling public; improves continually through safety data monitoring and feedback; and is promoted at all levels of the company. Safety Recommendation R-17-27 recommended that once Safety Recommendation R-17-26 is completed, Amtrak implement the SMS program throughout the company with resources sufficient to ensure that all levels of management and all labor unions involved with Amtrak operations accept and comply with the system. Both recommendations are currently classified *Open—Initial Response Received.*

Amtrak's vice president, safety, compliance, and training told investigators that Amtrak's new chief safety officer, who was hired in January 2018, had increased the focus on the implementation of the SMS. Moreover, he said that executive leadership had demonstrated its commitment to the SMS, but it was in an early phase of development. On November 1, 2018, Amtrak released an updated SSPP, which was framed within the four components of an SMS.[48]

Amtrak's efforts to mature its SMS are evident and constructive. In the latest edition of its SSPP, Amtrak presents its objectives to coordinate with host railroads to manage safety. For instance, in support of one of its safety goals, the SSPP indicates that "SC&T [Safety, Compliance, and Training] will partner with Operations to engage host railroads, states, and other stakeholders on the implementation of mitigations that reduce risk to an acceptable level on routes and operations where PTC has not been implemented."[49] The SSPP also requires engagement with host railroads for emergency preparedness.

However, the SSPP does not describe how its SMS will apply to host railroad operations. For instance, there is a discussion of safety risk management, but it does not state how Amtrak will implement and coordinate with each host railroad.[50] In section 2.1.1 Risk Identification of the

[47] FAA, "Safety Management System," (See website at https://www.faa.gov/about/initiatives/sms/).
[48] See document "NRPC SSPP REV A 11012018" in the public docket DCA18HR001.
[49] See Amtrak SSPP, page 14, in the public docket DCA18HR001.
[50] See Amtrak SSPP section "2.0 Safety Risk Management," pages 34-46, in the public docket DCA18HR001.

SSPP, it is noted that "as the SMS matures and SSWGs [system safety working groups] are implemented, the KNOT methodology (Know, Need to Know, Opinion, Think We Know) will be applied to holistically define the system for the applicable area (region/department)." The word "host" is not used in the section, and a description of how Amtrak will manage risk off-property in concert with the host railroads is not included.

Regarding safety assurances for the SMS, Amtrak's SSPP contains a provision for host railroad operations within the 3.0 Safety Assurance section.[51] However, the provision mandates that when Amtrak operates over host railroads it will "follow its operating rules, timetable/special instruction, and other operational instructions." In several interviews, Amtrak officials have indicated that Amtrak has now improved upon this policy. That is, Amtrak is now conducting risk assessments, and where risk is unacceptably high, implementing operational safety enhancements that increase safety beyond what the host railroad rules would require. Amtrak's SSPP should reflect such processes and specify who is responsible for its implementation.

Similarly, in other sections of the SSPP, the extent to which processes pertain to host railroad operations and who is responsible for managing such processes is not made clear. Though the SSPP is not the singular document that needs to include a detailed specification of safety management for each host railroad, it should at least specify where such information can be obtained, particularly in light of the fact that the host railroad agreements between Amtrak and each host railroad do not contain such information. Thus, the NTSB concludes that Amtrak has not yet articulated, nor implemented a strategy to integrate all aspects of host railroad operations into its SMS.

### 2.6.2 Host Railroad Agreements

Amtrak has indicated that the host railroad agreements are not intended to address safety but rather the operation of existing service, service standards, implementation of new service, payments, liability apportionment, and dispute resolution. During the NTSB investigative hearing, the director of host railroads stated that the host railroad agreements are commercial documents, not safety documents. The host railroad agreement between Amtrak and CSX contains minimal information pertaining to safety, although it does mandate that Amtrak shall follow all CSX "operating and safety rules, orders, procedures, and standards," which relate to the safety policy component of an SMS.[52] However, the agreement does not contain provisions pertaining to safety risk management, safety assurance, or safety promotion. Thus, the host railroad agreement between Amtrak and CSX is not a safety document and does not contain the provisions necessary to support an effective SMS.

Prior to the accident, Amtrak followed the operating rulebook of each host railroad without conducting any risk assessments. This was a suboptimal safety practice as evidenced by the current accident. Investigators spoke with several organizational leaders at Amtrak who said they realized the accident likely would not have occurred if it had been following its own operating rules through

[51] See Amtrak SSPP section "3.2.1.1.1 Host Railroad Operations," pages 49-50, in the public docket DCA18HR001.

[52] See the FAA website for a discussion of the components of SMS: https://www.faa.gov/about/initiatives/sms/explained/components/.

the signal suspension instead of CSX's operating rules. Had Amtrak been following its own rules, the train would have been required to approach the facing-point switch prepared to stop.

The vice president, safety, compliance and training indicated that to improve safety while operating on the tracks of host railroads, Amtrak would have to augment its host operating practices to improve operational safety. Amtrak's COO recognized that during signal suspensions, Amtrak had been exposing its crews and passengers to a higher level of risk in CSX territory than it was on its own property. Moreover, he recognized the importance of analyzing the risk of the host's operating procedures and implementing mitigations where necessary rather than simply accepting the host's rules. Amtrak's new chief safety officer shared a similar perspective, indicating that accepting the host railroad's rules without any real consideration was not the best solution for a passenger railroad.

Amtrak indicated that, since the accident, it implemented risk management processes to follow upon learning of a signal suspension on a host railroad. According to Amtrak, safety specialists now assess the risk to its trains as they travel through signal suspensions off property. Amtrak told investigators that under such situations, safer operating practices are being provided to its crews. Amtrak reported that it is also following these processes for other operating conditions such as track outages.

Although Amtrak told investigators that it made significant progress managing safety off property, the available evidence suggests that there are areas that still need to be addressed. Evaluating operating practices for employees in direct contact with the system and responding to changes in operating conditions are only two of the safety considerations that a rail transportation organization operating across rail lines owned by various organizations needs to consider. There are many safety-critical elements of railroading such as infrastructure, maintenance, signage, dispatching, and culture. Although Amtrak employees may not be engaged directly with certain aspects of operations on host railroad property, Amtrak must maintain responsibility for ensuring safe passenger and crew travel. For instance, although Amtrak is not responsible for dispatching trains on a CSX track, it must have assurances in place that that CSX can safely dispatch Amtrak trains.

### 2.6.3 Host Railroad Team

To provide nationwide passenger rail service, Amtrak operates within multiple systems. During the NTSB investigative hearing, staff asked Amtrak's COO how Amtrak works with host railroads to assess and mitigate risk on other systems. The COO stated that he was not an expert on Amtrak's host railroad processes, but if Amtrak had a safety concern they would "go through our Host Railroad Team."[53]

Investigators spoke with Amtrak's host railroads team members about the extent to which their job responsibilities included safety management. The director of host railroads said that his team seldom discussed safety, and the senior director of host railroads did not know if Amtrak had

[53] Supporting documentation can be found in the public docket for the NTSB investigative hearing, "Managing Safety on Passenger Railroads," July 10–11, 2018, accessible from the NTSB Accident Dockets web page by searching DCA18HR001.

ever successfully requested that a host railroad implement a different safety protocol. Moreover, the host railroads team was not readily able to articulate the extent to which safety provisions were contained in the host railroad agreements. Thus, Amtrak's host railroads team was largely uninvolved in the safety management of Amtrak trains operating on a host railroad's property.

### 2.6.4 Amtrak Safety Management on Host Railroads

The contributing factors surrounding the accident in Cayce present numerous examples of Amtrak's inability to control or influence the management of safety on the host railroad. When operating over the territory of a host railroad Amtrak is subjected to the risk mitigation strategies implemented by that host. Although there is a host railroad agreement in place between Amtrak and the host railroad, this agreement does not establish the parameters for safe operations and a consistent level of risk mitigation from host railroad to host railroad. Unfortunately, this accident is just one of several that are discussed below that have occurred recently where Amtrak has demonstrated its inability to control or influence the management of safety on the host railroad.

On October 5, 2015, at 10:22 a.m., southbound Amtrak passenger train 55, derailed at MP 65.2 on a single main track after striking a rock pile that fouled the right of way on the New England Central Railroad (NECR) near Northfield Vermont. The collision and subsequent derailment resulted in the locomotive and first coach car derailing and sliding down an embankment. Three additional coach cars derailed but remained upright and in-line near the track. This accident highlighted that, although Amtrak utilized a hazard management program on its owned and operated territory through its SSPP, this program was not applicable on a host railroad. The Amtrak SSPP hazard management program established a methodology for determining risk and the mitigation of this risk; the risks addressed by Amtrak included rock fall and rockslide areas along the Northeast Corridor and Harrisburg Line. In contrast, although the NECR had a safety program, at the time of the accident, the NECR did not have a formalized hazard management and assessment program as it pertains to rock fall risk management and mitigation (NTSB 2017a).

On March 14, 2016, at 12:02 a.m. central daylight time, Amtrak passenger train 4 derailed near MP 372.9 in the vicinity of Cimarron, Kansas. This Los Angeles to Chicago train consisted of 2 locomotives and 10 cars. The accident occurred off of Amtrak territory where Amtrak was hosted by BNSF Railway. A runaway feed truck from an adjacent feedlot impacted the railroad tracks and pushed the tracks out of alignment. At the location of the accident, there were no protective barriers or fencing placed along the right of way to prevent this undesirable intrusion (NTSB 2017c). Along the Amtrak-owned and Amtrak-operated Northeast Corridor and Harrisburg line, Amtrak implemented an intrusion prevention strategy to develop standards and install fencing and barriers to reduce the risk of vehicle intrusion onto the right of way.[54]

On December 18, 2017, at 7:33 a.m., Pacific standard time, southbound Amtrak passenger train 501, consisting of a leading locomotive and a trailing locomotive, a power car, 10 passenger railcars, and a baggage car, traveling at 78 mph, derailed from a highway overpass near DuPont, Washington. When the train derailed, it was on its first regular passenger service trip on a single main track (Lakewood subdivision) at MP 19.86. The lead locomotive, the power car, and two passenger railcars derailed onto Interstate 5. Fourteen highway vehicles came into contact with the

[54] Amtrak Intrusion Prevention on the NEC Presentation, November 16, 2015.

derailed equipment. At the time of the accident, 77 passengers, 5 Amtrak employees, and a Talgo Incorporated technician were on the train. Of these individuals, 3 passengers were killed, and 57 passengers and crewmembers were injured. Eight individuals in highway vehicles were also injured.

Following the Amtrak train 501 derailment in DuPont, Washington, Amtrak officials developed a risk assessment process to be used to evaluate the risks to Amtrak operations over a host railroad. The process includes utilizing expertise from Amtrak's System Safety Office and local transportation management officials. Since its development, according to Amtrak, this risk assessment process has been used 30 times by Amtrak.

These accidents highlight the significant difference in the approach to managing safety on Amtrak-owned and Amtrak-operated territory versus that of a host's railroad. Amtrak passengers should not be exposed to different levels of safety management based on who owns the tracks. Amtrak relies on host railroads to meet the minimum federal safety standards (49 CFR Parts 200 - 299) to ensure safe operations of Amtrak trains. However, in his interview with NTSB discussed in Section 1.15.1.4 in this report, Amtrak's CEO noted that on its own territory, Amtrak aims to meet and exceed this standard by not only meeting the FRA's minimum safety standards but also through the use of a voluntary SSPP and more recently in response to NTSB Safety Recommendations R-17-26 and R-17-27. As a result of similar findings in the investigation of the accident in DuPont, Washington, the NTSB issued Safety Recommendation R-19-27 to Amtrak:

> Work collaboratively with all host railroads and states that own infrastructure over which you operate in an effort to develop and implement a comprehensive safety management system program that meets or exceeds the pending Federal Railroad Administration regulation, Title 49 *Code of Federal Regulations* Part 270, "System Safety Program." (R-19-27)

As noted in Amtrak's submission for this accident, 97 percent of the nearly 21,000 route-miles Amtrak operates are owned by other railroads and subject to host agreements. This reliance on host railroads is a central feature of Amtrak's business model.[55]

Host railroad operations are too central to Amtrak's core business objectives to not be fully accounted for in its safety strategy. Amtrak must envision and then articulate in a written strategy a plan to ensure that risk is managed to a consistent low level across all systems where Amtrak trains operate. Amtrak should denote the specific responsible company positions for managing the safety of trains operating off property. The NTSB concludes this accident again shows that to improve safety for the public, Amtrak needs to implement an SMS on all operations whether internal or on a host railroad. Therefore, the NTSB reiterates Recommendation R-19-27 to Amtrak.

The circumstances of this accident show the need for the host railroad(s) to work with Amtrak to develop a comprehensive safety management system program. The NTSB concludes that the application of safety management principles must be uniform across the Amtrak network.

[55] See document "NRPC Submission – Cayce SC," page 2.

Therefore, the NTSB further recommends that all host railroads work in partnership with Amtrak to establish safety management criteria that support the implementation of Amtrak's SMS.

## 2.7 CSX Safety Management

The findings of the investigation raise concerns about CSX's safety management. As discussed above, CSX efforts to mitigate the risk associated with switch operations with signals suspended were insufficient. The risk associated with conducting switch operations without an active signal system are well documented. Several prior misaligned switch accidents are listed in this report, which all involved a human failing to line a switch properly. To mitigate this risk, CSX relied principally upon crews using a SPAF form, which is known to be a weak administrative control. An organization with effective risk management processes would have identified that the SPAF needed to be replaced with stronger controls that do not require error-free human performance such as switch position indicators.

Thus, the findings of the investigation suggest that CSX needs to improve its risk management. A comprehensive system that evaluates all risks, including but not limited to operations, training, maintenance, equipment, and medical standards, is needed. However, risk assessment is not the only process that needs to be developed for safety. Rather, risk assessment should be part of a comprehensive safety management system, which also includes safety policies, safety assurances, and safety promotions.[56] These components are necessary to manage safety.

According to the Federal Aviation Administration (FAA), safety policy establishes senior management's commitment to continually improve safety. Safety policy also defines the methods, processes, and organizational structure needed to meet safety goals. Safety promotion includes training, communication, and other actions to create a positive safety culture within all levels of the workforce. For CSX to manage the risk of both freight trains and passenger trains, which present unique risks carrying humans at high speeds, CSX will need to first articulate a strategy in the form of safety policies. CSX will also need to ensure that they have engineered a safety culture to support the execution of these goals.

SMS has been highly effective in improving safety for other organizations, particularly in the aviation industry. The Rail Safety Improvement Act of 2008, Section 103 directed FRA to create a mandatory risk reduction program (a major element of a safety management system) for passenger and freight railroads and established a deadline for the enactment of the Final Rule of October 16, 2012. FRA has issued a final rule on passenger railroads which has been stayed and not enacted. FRA has proposed rules in the Rail Safety Advisory Committee (RSAC) for the Class I freight railroads. These rules have not yet been approved by the RSAC. At this time, it is unknown when the FRA will complete its rulemaking. The NTSB concludes that to improve its risk management processes, CSX will need to develop and implement an SMS. The NTSB recommends that CSX develop and implement an SMS that includes but is not limited to operations, training, maintenance, equipment, and medical standards.

[56] See the FAA website for a discussion of safety management system components at https://www.faa.gov/about/initiatives/sms/explained/components/.

## 2.8 Government Regulation of Safety Management

On August 12, 2016, the FRA published a final rule, 14 CFR Part 270, requiring the development and use of SSPPs for all passenger rail operations. Since the final rule was published, the FRA has delayed implementation seven times. On June 12, 2019, the FRA published a new notice of proposed rulemaking that would further delay the effective date of this rule past the most recent date of September 4, 2019, to a new undetermined date.

In the investigation of the accident in Chester, Pennsylvania, the NTSB found that one of the challenges faced by all railroads in developing a formal SSPP has been the failure of the FRA to enact its final rule. Many of the railroads have designed their SSPP but are apprehensive about implementing their plan because of concerns that modifications will be necessary after the regulation is fully enacted. At the time of the NTSB's report on the accident in Chester, the FRA had delayed the rule's implementation four times. As a result, the NTSB issued Safety Recommendation R-17-17 to the FRA:

> Enact Title 49 *Code of Federal Regulations* Part 270, System Safety Program, without further delay. (R-17-17)

In the years since the rule was published, accidents have continued to occur. On April 22, 2019, pending implementation of the final rule, Safety Recommendation R-17-17 was classified *Open—Unacceptable Response*. The Chester accident occurred on Amtrak's own property. However, as shown by this accident and others, Amtrak operates on host railroads throughout the United States. The system safety regulation would not be limited to Amtrak property and would be applicable to all of Amtrak's operations, including those on host railroads. With the regulation in place, the relationship between the host railroad and Amtrak would be better defined, and Amtrak could present to the host railroads their regulatory obligations.

The NTSB concludes that the repeated postponement of 49 CFR Part 270, System Safety Program by the FRA has delayed needed safety improvements for the passenger rail industry and the traveling public. Therefore, the NTSB reiterates Safety Recommendation R-17-17 to the FRA.

# 3 Conclusions

## 3.1 Findings

1. None of the following was a factor in this accident: the mechanical readiness of the train or the condition of the track.

2. No medical condition or use of any medication by the Amtrak (National Railroad Passenger Corporation) crew contributed to the circumstances of the accident.

3. Due to the limited available medical information for the CSX Transportation Corporation train crew, it could not be determined whether any medical condition or use of medication contributed to the circumstances of the accident.

4. The majority of passenger injuries resulted from the passengers being thrown from their seats when the trains collided and derailed.

5. Although the passenger equipment safety standards in Title 49 *Code of Federal Regulations* Part 238 provide some level of protection for occupants, the current requirements are not adequate.

6. The two-person train crew performing switching that required the use of main track switches would have benefited from an additional train crewmember assisting with the operation of the main track switches because, in this unique situation the signal system did not provide a second level of safety for the operation of the main track switch.

7. The CSX Transportation Corporation train crew performed switching operations in the accident area for about 6 hours in a changed operating environment of a signal suspension without sufficient planning, a risk assessment, and the implementation of appropriate risk mitigations.

8. The changed environment of a signal suspension not only challenges the movement of trains and operating crews but also limits the effectiveness of the operating rules and regulations.

9. The CSX Transportation Corporation crew efficiency tests for the operation of main track switches, East Coast-1 authority, or the switch position awareness form failed to ensure safety.

10. The CSX Transportation Corporation conductor’s failure to realign the North End Silica Storage switch was an error of omission.

11. The switch position awareness form is an ineffective control that did not mitigate the risk of an improperly lined switch.

12. CSX Transportation Corporation failed to properly assess and mitigate the risk associated with conducting switching operations with the signals suspended.

13. The Federal Railroad Administration has failed to implement effective regulation to mitigate the risk of misaligned switch accidents.

14. Amtrak (National Railroad Passenger Corporation) has not yet articulated, nor implemented a strategy to integrate all aspects of host railroad operations into its safety management system.

15. This accident again shows that to improve safety for the public, Amtrak (National Railroad Passenger Corporation) needs to implement a safety management system on all operations whether internal or on a host railroad.

16. The application of safety management principles must be uniform across the Amtrak (National Railroad Passenger Corporation) network.

17. To improve its risk management processes, CSX Transportation Corporation will need to develop and implement a safety management system.

18. The repeated postponement of Title 49 *Code of Federal Regulations* Part 270, System Safety Program by the Federal Railroad Administration has delayed needed safety improvements for the passenger rail industry and the traveling public.

## 3.2 Probable Cause

The National Transportation Safety Board determines the probable cause of this collision of trains was the failure of the CSX Transportation Corporation to assess and mitigate the risk associated with operating through a signal suspension, which eliminated system redundancy for detecting a switch in the wrong position. The CSX Transportation Corporation conductor failed to properly reposition the switch for the main track, which allowed National Railroad Passenger Corporation (Amtrak) train P91 to be routed onto the Silica Storage track where the standing CSX train F777 was located. Contributing to the accident was the Federal Railroad Administration's failure to implement effective regulation to mitigate the risk of misaligned switch accidents. Also contributing to the accident was National Railroad Passenger Corporation's (Amtrak) failure to conduct a risk assessment prior to operating during a signal suspension.

# 4 Recommendations

## 4.1 New Recommendations

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

**To the CSX Transportation Corporation:**

> Develop a device or technique to eliminate the possibility of employees failing to perform critical tasks such as lining a switch, lining a derail, or ensuring cars are clear of the main track. (R-19-36)
>
> Develop and implement a safety management system that includes but is not limited to operations, training, maintenance, equipment, and medical standards. (R-19-37)

**To All Host Railroads:**

> Work in partnership with Amtrak (National Railroad Passenger Corporation) to establish safety management criteria that support the implementation of Amtrak's safety management system. (R-19-38)

## 4.2 Reiterated Recommendations

As a result of this investigation, the National Transportation Safety Board reiterates the following previously issued safety recommendations:

**To the Federal Railroad Administration:**

> Conduct research to evaluate the causes of passenger injuries in passenger railcar derailments and overturns and evaluate potential methods for mitigating those injuries, such as installing seat belts in railcars and securing potential projectiles. (R-16-35)
>
> When the research specified in Safety Recommendation R-16-35 identifies safety improvements, use the findings to develop occupant protection standards for passenger railcars that will mitigate passenger injuries likely to occur during derailments and overturns. (R-16-36)
>
> Enact Title 49 *Code of Federal Regulations* Part 270, System Safety Program, without further delay. (R-17-17)
>
> Require railroads to develop a device or technique to eliminate the possibility of employees failing to perform critical tasks such as lining a switch, lining a derail, or ensuring cars are in the clear. (R-18-10)

**To Amtrak:**

> Work collaboratively with all host railroads and states that own infrastructure over which you operate in an effort to develop a comprehensive safety management system program that meets or exceeds the pending Federal Railroad Administration regulation, Title 49 *Code of Federal Regulations* Part 270, “System Safety Program.” (R-19-27)

## 4.3 Reclassified Recommendations

As a result of this investigation, the National Transportation Safety Board reclassified the following previously issued recommendations:

**To the Federal Railroad Administration:**

> Issue an Emergency Order directing railroads to require that when signal suspensions are in effect and a switch has been reported relined for a main track, the next train or locomotive to pass the location must approach the switch location at restricted speed. After the switch position is verified, the train crew must report to the dispatcher that the switch is correctly lined for the main track before trains are permitted to operate at maximum-authorized speed. (R-18-5) (Urgent)
>
> Safety Recommendation R-18-5 is classified “Closed—Unacceptable Action.”
>
> Require railroads to develop a device or technique to eliminate the possibility of employees failing to perform critical tasks such as lining a switch, lining a derail, or ensuring cars are in the clear. (R-18-10)
>
> Safety Recommendation R-18-10 is classified “Open—Unacceptable Response.”

## BY THE NATIONAL TRANSPORTATION SAFETY BOARD

**ROBERT L. SUMWALT, III**
Chairman

**JENNIFER HOMENDY**
Member

**BRUCE LANDSBERG**
Vice Chairman

**Date: July 23, 2019**

# Board Member Statement

**Vice Chairman Bruce Landsberg filed the following concurring statement on July 25, 2019. Chairman Robert L. Sumwalt, III and Member Jennifer Homendy joined in this statement.**

This accident was yet another in a long string of railroad switching disasters due to both human and systemic failures. During the board meeting we had some enthusiastic discussion regarding the sequencing of how probable cause should be stated. Should the conductor who failed to realign a switch be listed first or should the inadequate CSX Transportation Corporation (CSX) signal suspension system procedure come first? Why does it matter? Because sequencing carries at least some weight in terms of importance but ultimately – both need to be fixed.

CSX certainly should have better systems in place, which might have prevented this accident, but they had a record of success in their switching operations. According to CSX's party submission, they had conducted over 900 signal suspensions over the past decade without a single failure, using the procedures that were in place prior to the Cayce accident. We'll never know how many close calls occurred. That must be taken at face value.

There should be no exoneration of CSX's systemic mismanagement, but individuals in safety-sensitive positions, such as conductors, engineers, and dispatchers also bear critical responsibilities. Until a system becomes more fault tolerant, it's incumbent on rail workers to recognize the additional risk during signal suspensions. Sadly, despite the mitigations that have worked for the previous decade, the CSX conductor made an error that caused a train collision and cost two Amtrak (National Railroad Passenger Corporation) employees their lives. Clearly, this isn't an either/or situation.

Organizationally, the National Transportation Safety Board (NTSB) tends to focus on systemic causes because that is where strategic and long-term improvements can be made. Until a safety management system (SMS) is fully functional, however, the system still depends on fallible humans. And, even when an SMS becomes fully implemented, humans still play a role.

Current railroad operating culture tends toward the enforcement side rather than the compliance view When an individual makes a mistake, which is inevitable to humans, the response is often punitive rather than educational. Follow the rules, regardless of how archaic they might be, and everything will be fine. BUT, if something happens – you're in trouble. This culture is unhealthy and counterproductive.

There is some good news coming out of this accident. Both Amtrak and CSX have implemented significantly better procedures and while it will take some time for them to become fully effective, their operations should become noticeably safer. Until that happens, though, crews need to understand that they are the last defense against disaster. They should take that responsibility very seriously.

Systemic change comes slowly in too many cases. Misaligned switch crashes have been problematic to the rail industry since the beginning, but we have much better technology and operating experience today. The NTSB has made multiple recommendations to the railroads and to the Federal Railroad Administration (FRA) dating back years. Congress has mandated that the FRA make changes. But economics and bureaucratic inertia seem to be more important than the safety of rail workers and passengers. The real price of preventing accidents, especially with readily available technology, or barring that, simple procedural changes, is cheap compared to the carnage that we've seen. We can do better and perhaps we're on the cusp of a new age of railroad safety.

# Appendixes

## Appendix A: Investigation

The National Transportation Safety Board (NTSB) was notified on February 4, 2018, of the accident in which Amtrak's Silver Star passenger train had collided with a parked CSX Transportation Corporation (CSX) local freight train in Cayce, South Carolina. Initially, there was an unknown number of injured passengers; however, early on it was confirmed that two crewmembers of the Amtrak (National Railroad Passenger Corporation train died. The NTSB launched Chairman Robert Sumwalt, who was the on-scene spokesperson, an investigator-in-charge, and a team to investigate track, signals, and train control; railroad operations; mechanical functions; crashworthiness; event/data/and video recorders; human performance; and medical issues.

NTSB investigators from Washington, DC, Atlanta, Georgia, and Chicago, Illinois, assisted in the investigation. The NTSB Transportation Disaster Assistance Division was also on scene to provide assistance with victims and victims' families.

The NTSB held a 2-day investigative hearing, Managing Safety on Passenger Railroads, on two Amtrak accidents on July 10-11, 2018. The public hearing, which was held at the NTSB headquarters in Washington, DC, explored the issues involved in the December 18, 2017, derailment in DuPont, Washington, and the February 4, 2018, collision with a CSX freight train near Cayce, South Carolina.

Parties to the hearing included the Federal Railroad Administration (FRA); State of South Carolina Office of Regulatory Staff; the International Association of Sheet Metal, Air, Rail and Transportation Workers; the Brotherhood of Locomotives Engineers and Trainmen; the Brotherhood of Railroad Signalmen; CSX; and Amtrak.

The transcript of the hearing proceeding is available in the public docket.

# Appendix B: April 23, 2019, Amtrak E-mail Response on Operating Rules for Signal Suspension on Tracks It Controls

As mentioned in section 1.17.2, the NTSB asked Amtrak to clarify its operating rules at the time of the accident and received several e-mails in response on April 23, 2019. This appendix provides additional details from Amtrak's response.

> On the NEC, we do not plan "Signal Suspensions" and instead will remove tracks from service; since we have multiple tracks we can use to run around this type of work. C&S Department employees would not leave areas under signal/PTC maintenance unmanned without control and without removing the track(s) from service. In the event we did plan to remove a control point/interlocking from service and intended to run, the below NORAC rule 406 D would apply:

**406. ABS Failure: Non-signaled DCS Substitution**

**A. Form D Line 6 or Bulletin Order**

When an ABS failure occurs, non-signaled DCS rules may be substituted by Bulletin Order or Form D line 6.

All trains and Operators affected must receive a copy of the Form D line 6 or Bulletin Order. Before the Dispatcher issues the Form D line 6 or before the Bulletin Order becomes effective, the Dispatcher must ensure that:

1. Interlocking and CP signals governing entrance to or within the affected limits are in Stop position,
   AND
2. Blocking devices are applied to the controls of switches and signals leading to the affected limits.

Interlocking or CP signals governing entrance to or within the affected track may be displayed to authorize movements that have received Form D line 2 authority. Signal indication will govern movement within interlocking limits or CP only. These signals must be immediately restored to Stop position and blocking devices reapplied once the head end of the authorized movement has passed the signal.

**B. Rules-in-effect**

ABS and CSS rules do not apply when non-signaled DCS rules are substituted for ABS.

**C. Highway Grade Crossings**

Unless otherwise instructed by Bulletin Order or Form D line 13, trains must stop and provide on-ground warning at highway grade crossings equipped with automatic warning devices, unless:

1. The automatic warning device has been operating at least 20 seconds,
   OR
2. If equipped with gates, they are in the horizontal position.

The leading end of the movement must not exceed 15 MPH over the crossing.

**D. Form D Line 7: Interlocking or Controlled Point Removed from Service**

Interlocking and controlled point signals remain in service unless otherwise specified by Bulletin Order or Form D line 7. Before the Dispatcher issues Form D line 7 or before the Bulletin Order becomes effective, the Dispatcher must ensure that switch points at interlockings or controlled points to be removed from service have been spiked or wedged for the route to be used. If the route to be used is diverting, Form D line 1 or Bulletin Order item must be issued to indicate speed over diverting route.

Interlockings that include a movable bridge or a railroad crossing at grade must not be removed from service in this manner.

On the occasion we have a loss of signal power, usually due to heavy storms, we write Movement Permit Form Ds to trains, issued one at a time, under Absolute Block (only one train between controlled signals at a time). Before we do this however, we run one train at restricted speed through the entire affected area to ensure there are no conditions between the start and end point that would cause harm to other trains (TDM 4.17 below) that might receive a Form D to operate 59 MPH. In both instances, trains are required to be prepared stop short of any misaligned non-interlocked facing point switches (hand thrown). The dispatcher applies blocking devices to all other switches that might otherwise be under his control.

Additionally, due to the high volume of trains we run on the NEC, we don't always write the Form D's to operate 59 MPH and simply have trains operate at restricted speed because each train needs to be manually tracked between each block and the workload on the dispatcher to issue that many Form D's increases the risk of a mistake. Except on rare occasion, these conditions only exist for an hour or two.

We also list the location of switches in our special instructions. In addition, due to the PTC mitigation agreement with NJT, we will soon show where the hand operated switches are in 251 territory (signaled in one direction).

Our NEC Instructions for Amtrak Controlled Territory are below:

**401. Operating in Non-Signaled DCS Territory**

**A. Maximum Authorized Speed**
Passenger trains must not exceed 59 MPH and freight trains must not exceed 49 MPH, unless otherwise restricted.

**B. Approaching Home Signals, Controlled Point Signals, and Signals at the Beginning of ABS Territory**
Trains must approach home signals, controlled point signals, and signals at the beginning of ABS territory prepared to stop, unless a distant signal is in service. If a train is delayed after passing a distant signal, it must approach the home signal or controlled point signal prepared to stop.

NEC GO703 Special Instruction:

**401-S1. NON-INTERLOCKED FACING POINT SWITCHES**
Trains operating under the DCS rules must not pass over non-interlocked facing point switches until it is ascertained that the switch is properly lined.

Train Dispatcher's Manual:

**4.17 SUBSTITUTING DCS RULES FOR ABS RULES**

In the event of a signal system failure, DCS rules may be substituted for ABS rules in accordance with the procedures outlined in the Division section of this manual, *after at least one train has operated through the area* to determine that the track is not obstructed.

# Appendix C: Switch Position Awareness Form

SWITCH POSITION AWARENESS FORM (REV. 10.05)

C&E/EMPLOYEE TRAIN ID/EMPLOYEE ID DATE

| SUBDIVISION TTSI CODE AND SWITCH HANDLED LOCATION NAME | TIME SWITCH | | EMPLOYEES INITIALS | |
|---|---|---|---|---|
| | REVD | NORM | EMPLOYEE HANDLING SWITCH | ENGINEER/ CO-WORKER |
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CONDUCTOR/EMPLOYEE IN-CHARGE SIGNATURE: ______________________________

# Appendix D: CSX Centralized Train Dispatching and Authorities for Movement

The following are quotations from the CSX Rulebook regarding CSX switch operating rules.

504.13

Do not open a switch that provides access to a signaled track unless authorized by signal indication or permission of the train dispatcher. Permission of the train dispatcher is required to:

1. Unlock an electrically locked switch, or

2. Break the seal to operate the emergency release of an electrically locked switch, or

3. Place a dual-controlled power-operated switch in hand position or operate in hand position, or

4. Spike a non-dual-controlled power-operated switch.

5. Effective April 1, 2017.

504.36

Unless otherwise specified, when signals are temporarily removed from service, trains must:

1. Approach all Absolute signals prepared to stop and not pass these signals without permission of the train dispatcher,

2. Stop at drawbridges and railroad crossings at grade and be governed by rules or special instructions in effect for that particular location,

3. Approach all public crossings at grade that are equipped with automatic grade crossing warning devices prepared to stop and provide protection,

4. Examine switch points of spring switches to confirm they are lined and switch is locked before making a facing point movement, and

5. Operate switches and derails in accordance with rules governing operating switches and derails by hand.

CSX Track Warrant Control

<u>505</u>

When the authority for movement on a controlled track is designated in special instructions, dispatcher message, or Form EC-1 as TWC-D, trains will be governed by verbal authority from the train dispatcher.

Trains must not enter controlled track in TWC-D territory unless authorized to do so by the train dispatcher, or as a work train working as part of the engineering work group within designated working limits.

<u>505.9</u>

A train must report by specific locations when directed by the train dispatcher. Once a train has reported by a specific location, the train must not re-enter that section of track unless a new authority is obtained.

<u>505.10</u>

A track warrant authority is fulfilled when a train operating in a specified direction clears the limits. After a train clears the limits of its track warrant authority, the conductor or the locomotive operator must promptly release the authority unless otherwise directed by the train dispatcher.

<u>505.11</u>

A train must not release an authority or report by a specific location until:

1. A crewmember or other employee observes the rear end marker or verifies the rear car's initials and number, or

2. The train passes a defect detector that gives an axle count that agrees with the count of a previous defect detector or an actual count made by a crewmember, or

3. The train clears the controlled track at a hand-operated switch and the switch (and derail, if equipped) has been restored and locked in normal position, or

4. A train equipped with properly functioning telemetry:

    a. Indicates the rear of the train is intact,

    b. The display indicating air pressure on the rear of the train gives the expected reading, and

    c. The distance traveled by the leading end of the train is:

(1) The train's length, as determined by the use of the odometer on the HTD, or

(2) Three miles beyond the clearing point.

505.12

Location

1. Complete the Switch Position Awareness Form (SPAF) in ink,
2. Report the following to the train dispatcher:
    a. Location of the switch operated,
    b. Switch(es) restored and locked in normal position,
    c. Time switch was initially reversed,
    d. Time switch was restored and locked in normal position, and
    e. Name of employee who operated the switch.
3. Retain the Switch Position Awareness Form (SPAF) until the next tour of duty.

608.8

When hand-operated switches are used in Track Warrant Control non-signal territory (TWC-D), the train dispatcher must use the train dispatcher radio to confirm:

1. Location of the switch(es) operated,
2. Switch(es) were restored and locked in normal position,
3. Time switch(es) were initially reversed,
4. Time switch(es) were restored and locked in normal position,
5. Name of the employee who operated the switch(es), and
6. The Switch Position Awareness Form (SPAF) was initialed by both the conductor and locomotive operator.

CSX Operating Switches and Derails by Hand

401

Employees are individually responsible for the switch in use and must not operate a switch or derail until qualified on operating and safety rules related to the operation of the device.

Before lining a switch or derail, the employee must ensure:

1. There are no conflicting movements;

2. Any preceding movement has passed the clearance point;

3. The device is not locked, clamped, spiked, or tagged out of service; and

4. No obstructions will interfere with normal movement of the switch points or the handle.

Rolling equipment must not foul a track until it can be visually determined that:

1. Switches and derails connected with the movement are properly lined, and

2. The intended route is clear.

Do not unlock or operate a switch or derail that provides access to a controlled track unless authorized by:

1. Verbal authority from the train dispatcher, or

2. Signal indication.

## Appendix E: FRA Safety Advisory – Temporary Signal Suspensions

The following is the verbatim text of a Safety Advisory on Temporary Signal Suspensions that was filed in the *Federal Register by* the FRA on November 19, 2018 (*Federal Register* 2018, 58685).

DEPARTMENT OF TRANSPORTATION

Federal Railroad Administration

[Docket No. FRA–2018–0037; Notice No. 2;

Safety Advisory 2018–02]

Safety Advisory Related to Temporary

Signal Suspensions

**AGENCY:** Federal Railroad

Administration (FRA), Department of

Transportation (DOT).

**ACTION:** Notice of Safety

Notice of Safety Advisory.

Summary

FRA is issuing this Safety Advisory addressing railroad operations under temporary signal suspensions. This Safety Advisory recommends the use of industry best practices when planning and implementing temporary signal suspensions, including when conducting rail operations under temporary signal suspensions. This Safety Advisory also recommends that railroads develop and implement procedures and practices consistent with the identified best practices and that railroads take certain other actions to ensure the safety of railroad operations during temporary signal suspensions. FRA believes that actions consistent with this Safety Advisory will reduce the risk of serious injury or death both to railroad employees and members of the public.

For Further Information Contact

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Supplementary Information

Background

On April 23, 2018, FRA published a notice of a draft Safety Advisory in the Federal Register addressing railroad operations during temporary signal suspensions. 83 FR 17701. As stated in the draft Safety Advisory, a review of FRA's accident/incident data shows that overall, rail transportation, both passenger and freight, is safe. However, recent rail accidents occurring in areas where a railroad has temporarily suspended the signal system, typically for purposes of maintenance, repair, or installation of additional components for a new or existing system, demonstrate that rail operations during signal suspensions present increased safety risks. In the draft Safety Advisory, FRA specifically noted the February 4, 2018 accident in Cayce, South Carolina, in which the engineer and conductor of National Railroad Passenger Corporation (Amtrak) Train P09103 were killed and 115 passengers injured,(1) when their train collided head-on with a CSX Transportation, Inc. freight train (Train F77703). As noted in the draft Safety Advisory, while the cause of this accident has not yet been determined, FRA's preliminary investigation indicates that despite the CSX train crew reporting to the train dispatcher that the switch was lined correctly, the crew did not restore the main track switch to its normal position as required by Federal regulation (Title 49 Code of Federal Regulations (CFR) 218.105) and CSX's own operating rules. The misaligned switch diverted the next train to traverse the location (the Amtrak train) into the siding and into the standing CSX train parked on the siding.

In the draft Safety Advisory, FRA also noted the March 14, 2016 accident near Granger, Wyoming, which occurred when a Union Pacific Railroad (UP) freight train traveled from the main track through a misaligned switch into a controlled siding and collided head-on with another UP freight train standing on the siding.

Notably, both the Cayce and Granger accidents occurred while the operating railroads were installing and testing positive train control (PTC) technology and while the railroads had temporarily suspended the signals in the accident areas to perform installation and testing activities. In the Granger accident, while the signals were suspended, UP established absolute blocks intended to provide for the safe movement of trains through the area without signals. In the Cayce accident, the Amtrak train was operating on a track warrant and at the time of the accident, signal personnel had stopped working for the day, yet the temporary signal suspension remained in place.

As explained in the draft Safety Advisory, the National Transportation Safety Board (NTSB) determined that the probable cause of the Granger accident was the employee-in-charge incorrectly using information from a conversation with the train dispatcher as authorization to send a train into the area where the signal system suspension was in effect. The NTSB also found that a contributing factor was the conductor pilot's failure to check the switch position before authorizing the train to enter the area. Both FRA and the NTSB's investigations into the Cayce accident are ongoing and while neither agency has yet issued any formal findings, on February 13, 2018, the NTSB issued a Safety Recommendation Report [(2)] to FRA regarding train operations during signal suspensions. In its report, the NTSB recommended that FRA issue an emergency order directing railroads to require train crews to approach switches at restricted speed when signal suspensions are in effect and a switch has been reported relined for a main track (NTSB Safety Recommendation R-18-005). The NTSB further recommended that after the switch position is verified, train crews should be required to report to the dispatcher that the switch is correctly lined for the main track before subsequent trains are permitted to operate at maximum-authorized speed.

FRA issued the draft Safety Advisory consistent with the purpose of the NTSB's recommendation and to ensure all railroads were made aware of both the safety concerns identified and information and practices available to specifically address the issues raised. Moreover, FRA intended the draft Safety Advisory to provide railroads the flexibility to review and revise their existing operating rules and practices as necessary to ensure the safety of their operations, without imposing rigid and inherently limited, new requirements on the industry. FRA intended the draft Safety Advisory to provide an opportunity for interested parties and industry experts to provide input on potential ways to prevent future accidents such as those that occurred in Granger and Cayce by sharing known industry best practices and seeking input on the same.

In the draft Safety Advisory, FRA noted the following best practices that some railroads were already implementing:

- Taking all practical measures to ensure sufficient personnel are present to continue signal work until the system is restored to proper operation. If sufficient personnel are not present, the signal suspension is terminated until such time as sufficient personnel are on hand.

- If a railroad elects to allow train traffic through signal suspension limits:

  ○ Establishing the smallest limits possible for the signal suspension (if possible, no more than three (3) control points or use phased limits to allow restoration of the signal system as work is completed);

  ○ Minimizing the duration of the signal suspension to the shortest time period possible (if possible, no more than twelve (12) hours); and

  ○ Taking all practical measures to ensure only through traffic is allowed to operate within the limits (avoiding any train meets or any movements requiring the manipulation of switches within the suspension limits).

- If any switches within the suspension limits are manipulated, consistent with 49 CFR 218.105, establishing an effective means of verifying that all switches have been returned to the proper position prior to any train traffic operating through the limits. (For example, require spiking or clamping of switches

> followed by locking for through movement after use; utilize a signal employee to tend the switch and to establish agreement between assigned crewmembers and the switch tender that the switch is properly lined; and/or require the first train through the limits after the manipulation of any switch to operate at restricted speed).

Among other recommendations, in the draft Safety Advisory, FRA recommended that railroads develop and implement procedures and practices consistent with these industry best practices for operations conducted under temporary signal suspensions. FRA also recommended that railroads increase supervisory operational oversight and conduct operational testing on the applicable operating rules pertaining to the operation of hand-operated main track switches and that this increased oversight should include face-to-face initial job briefings with all train and engine crews that will operate in any area where the signal system will be temporarily suspended.

Discussion of Comments Received in Response To Draft Safety Advisory

In response to the draft Safety Advisory, FRA received comments from the NTSB, the Association of American Railroads and the American Short Line and Regional Railroad Association (AAR/ASLRRA), Amtrak, the Brotherhood of Locomotive Engineers and Trainmen (BLET), the Transportation Division of the International Association of Sheet Metal, Air, Rail and Transportation Workers (SMART) and individuals involved in railroad transportation. Some commenters, including the NTSB, BLET, and SMART expressed the view that FRA's issuance of a Safety Advisory did not go far enough to address the safety issues associated with signal suspensions. These commenters expressed the view that FRA should mandate solutions through the regulatory process.(3) FRA respectfully disagrees with these commenters. FRA believes that when properly implemented and complied with, FRA's existing regulations (*e.g.*, 49 CFR part 218, subpart F) and the railroads' related operating rules effectively address the safety issues involved. Moreover, given the variety of circumstances under which railroads may need to temporarily suspend signal systems, FRA does not believe mandating a “one size fits all” solution is practical or in the interest of railroad safety.

The NTSB further commented that the draft Safety Advisory offered “contradictory statements” in noting that the Advisory provided railroads the “flexibility to review and revise their existing operating rules and practices as necessary to ensure the safety of their rail operations, without imposing rigid, and inherently limited, new requirements on the industry” and at the same time stating that temporary signal suspensions “are necessarily common occurrences” and that “rail operations under signal suspensions should be rare and appropriately limited.” These statements are not contradictory. FRA recognizes that signal suspensions are necessary to maintain and upgrade signal systems. In recent years railroads have improved upon installation and testing processes to minimize the extent and duration of signal suspensions. Furthermore, some railroads have sought to limit or prohibit operations through signal suspensions, and FRA agrees that in some circumstances, limiting or prohibiting operations through signal suspensions may be appropriate. Accordingly, in this Safety Advisory, FRA is recommending that before initiating a planned temporary signal system suspension, a railroad conduct a risk assessment to, among other things, evaluate whether rail operations through and/or within the suspension limits should continue during the suspension.

The NTSB further recommended that FRA require railroads, when operating trains during signal suspensions, to establish “an effective means for verifying that all switches have been returned to the proper position prior to any train traffic operating through” the suspension limits. The NTSB agreed with FRA's statement in the draft Safety Advisory that spiking or clamping switches, followed by locking the switches for through movement after use is one way to effectively verify switch position. In its comments, the NTSB also reiterated its Safety Recommendation R-18-005 recommending that FRA require train crews to approach switches at restricted speed when signal suspensions are in effect and a switch has been reported relined for a main track. The NTSB also recommended FRA convert the draft Safety Advisory into a regulation. As noted previously, FRA does not agree with this recommendation. FRA does, however, agree with the NTSB, and other commenters' recommendation that restricted speed may be an effective mitigation measure, and in this Safety Advisory FRA is specifically reiterating that as a potential best practice to be employed as appropriate.

BLET echoed the NTSB's restricted speed recommendation and expressed the view that it is irrelevant that both the Granger and Cayce accidents occurred while signal suspensions were in effect. Instead, from an operational standpoint, BLET asserted that the issue needing to be addressed is misaligned switches in non-signaled territory. As such, BLET expressed the view that FRA should not only implement NTSB Safety Recommendation R-18-005 as a regulation, but FRA should also implement the NTSB's Safety Recommendation R-12-29. NTSB Safety Recommendation R-12-29 recommended that until appropriate switch position warning technology is installed on main track switches, the first train through any dark territory after a main track switch had been reported relined for the main track must approach the switch location at restricted speed until the train crew reported to the dispatcher that the switch is correctly lined for the main track.[(4)]

SMART urged FRA to establish “uniform safety procedures” noting that many SMART members operate trains over more than one railroad. In addition, SMART suggested FRA issue an emergency order requiring railroads to adopt the best practice of spiking and locking main track switches when trains operate over a section of track where a signal system is suspended or “turned off and abandoned.”

In their comments, AAR/ASLRRA expressed agreement with the draft Safety Advisory's recommendation that railroads develop and implement procedures and practices for operations under temporary signal suspensions consistent with industry best practices. In their comments, however, AAR/ASLRRA suggested that certain aspects of the best practices FRA identified in the draft Safety Advisory should be modified. Specifically, AAR/ASLRRA suggested that FRA's recommended best practices should not limit signal suspensions to three control points and 12 hours in duration. Instead, noting the often complex nature of signal work, AAR/ASLRRA suggested that best practices should simply be for railroads to limit the number of control points involved in signal suspensions and the duration of the signal suspensions to the extent practicable. AAR/ASLRRA also expressed agreement with FRA's recommendation for increased supervisory operational oversight of the application of operating rules regarding the operation of hand-operated switches, but suggested that face-to-face initial job briefings with train and engine crews operating in signal suspension areas are “not always feasible” or the most effective solution. Thus, AAR/ASLRRA suggested that FRA revise its recommendation to allow for job briefings regarding temporary signal suspensions through bulletin or notice from the dispatcher, as opposed to a face-to-face job briefing. Given the variety of reasons a railroad may choose or need to suspend its signal system and the variety of circumstances under which such suspensions are conducted, FRA generally agrees with AAR/ASLRRA's comments that no geographic limit or time duration should be specified as a matter of industry-wide best practice. Accordingly, FRA believes railroads should limit the geographic scope and time duration of signal suspensions to the extent possible given the particular circumstances, but agrees that no hard limit on the number of control points, specific ways of limiting the geographic scope (such as using phased limits), or duration of signal suspensions should be specified. FRA also generally agrees that face-to-face job briefings may not always be practical if a signal suspension results from an unplanned event, such as a storm as referenced in AAR/ASLRRA's comments. This Safety Advisory, however, is specifically directed to the best practices for carrying out planned signal suspensions and thus, AAR/ASLRRA's comment on job briefings is outside the scope of this Advisory.

Amtrak generally expressed support for the recommendations in the draft Safety Advisory and additionally shared its experience in developing and implementing a Safety Management System (SMS) to enhance communication of safety concerns and issues. Amtrak also referenced its February 2018 initiation of the development of a formal risk assessment methodology to identify, analyze, assess, and mitigate risks due to human error associated with operating passenger service through territories in which the normal signal systems have been temporarily suspended. Amtrak explained that upon notification of a signal system suspension from a host railroad, using a collaborative process with departments across the railroad (including Operating Practices, System Safety, and local Train and Engine staff), Amtrak performs a risk assessment to identify appropriate operational mitigations including, but not limited to, speed restrictions, alternate routing, or service suspensions. Amtrak explained that each risk assessment and the mitigations prescribed are reviewed and approved by Amtrak senior leadership and the results of that assessment and approved operational mitigations are communicated to affected employees and shared with Amtrak's host railroad. Amtrak indicates in its comments that it has performed over thirty risk assessments and is committed to continuously improving the assessment process. FRA believes Amtrak's comments have merit and in this Safety Advisory is revising its recommendations to railroads to include a risk assessment component.

Safety Advisory 2018-02

Railroads suspend signal systems for a variety of reasons, including for maintenance or repair purposes, to install a new system, or to add additional components to an existing system. As exemplified by the accidents described above, rail operations under the temporary loss of protections provided by an existing signal system have the potential to introduce new safety risks and amplify existing safety risks because railroad employees accustomed to the safety an existing signal system provides must operate in an environment they may not encounter on a regular basis. A temporary signal suspension requires operating employees to immediately apply operating rules and practices different from those to which they are accustomed. Because a person's routine may include learned habits that are difficult to set aside when a temporary condition is imposed, operating employees may also need specialized instruction on the applicable rules and practices. Such risks must be addressed to provide for the safety of train operations during the loss of protection afforded by the signal system.

As discussed in detail in the draft Safety Advisory, Federal regulations require railroads to apply for FRA approval for certain discontinuances and modifications of signal systems, but Federal regulations do not prohibit railroads from temporarily suspending existing signal systems for purposes of performing maintenance, upgrades, repairs, or implementing PTC technology. *See* 49 CFR 235.7. FRA does not believe that Federal regulations should include such a prohibition. FRA's regulations already require individual railroads to adopt and comply with operating rules addressing the operation of hand-operated main track switches. *See* 49 CFR 218.105.

In addition to the regulatory requirements, virtually all railroads have adopted additional operational protections to ensure the safety of rail operations when an existing signal system is temporarily suspended. FRA believes certain operational safeguards that railroads already undertake constitute the best practices within the industry when temporarily suspending a signal system. These best practices include:

- Take all practical measures to ensure sufficient personnel are present to continue signal work until the system is restored to proper operation. If sufficient personnel are not present, terminate the signal suspension until sufficient personnel are on hand.

- If a railroad elects to allow train traffic through signal suspension limits:

    - Establish the smallest limits possible for the signal suspension;

    - Minimize the duration of the signal suspension to the shortest time period possible;

- ○ Take all practical measures to ensure only through traffic is allowed to operate within the limits (avoiding any train meets or any movements requiring the manipulation of switches within the suspension limits).

- If any switches within the signal suspension limits are manipulated, consistent with 49 CFR 218.105, establish an effective means of verifying that all switches have been returned to the proper position prior to any train traffic operating through the limits (for example, require spiking or clamping of switches followed by locking for through movement after use; utilize a signal employee to tend the switch and to establish agreement between assigned crewmembers and the switch tender that the switch is properly lined; and/or require the first train through the limits after the manipulation of any switch to operate at restricted speed).

*Recommendations:* After careful consideration of the comments received in response to the draft Safety Advisory, and to ensure the safety of the Nation's railroads, their employees, and the public, FRA recommends that railroads take immediate actions consistent with the following:

1. Before initiating a planned temporary suspension of a signal system, perform a risk assessment to determine the most effective and safest way to implement the suspension. The risk assessment should include consideration of the need to minimize the geographic scope and duration of the suspension and evaluate whether rail operations through and/or within the suspension limits should continue during the suspension. If a railroad concludes operations through or within the suspension limits may continue, the risk assessment should identify appropriate operational mitigations including, but not limited to, speed restrictions or alternate routing. The risk assessment should be performed with the input of all affected railroad departments (*e.g.*, Operating, Signal and Train Control, System Safety, and involved Train and Engine Staff), and any approved operational mitigations should be clearly communicated to all affected employees in advance of initiating the suspension or allowing the employees to operate through or within the suspension limits.

2. Develop and implement procedures and practices consistent with the industry best practices discussed above for rail operations conducted under temporary signal suspensions.

3. Inform employees of the circumstances surrounding the February 4, 2018, accident in Cayce, South Carolina, and the March 14, 2016, accident near Granger, Wyoming, discussed above, emphasizing the potential consequences of misaligned switches and the relevant Federal regulations and railroad operating rules intended to prevent such accidents.

4. Review, and as appropriate, revise all operating rules related to operating hand-operated main track switches (including operating rules required by 49 CFR 218.105), to enhance them to ensure (a) train crews and others restore switches

to their normal position after use, and (b) the position of switches are clearly communicated to train control employees and/or dispatcher(s) responsible for the movement of trains through the area where the signal system is temporarily suspended. In doing so, railroads should pay particular attention to those main track switches where employees report clear of the main track to the train dispatcher.

5. Increase supervisory operational oversight and conduct operational testing on the applicable operating rules pertaining to the operation of hand-operated main track switches. This should include face-to-face initial job briefings with all train and engine (T&E) crews that will operate in any area where the signal system will be temporarily suspended.

6. Enhance instruction on the relevant operating rules concerning the operation of hand-operated main track switches in non-signaled territory, including the operating rules required by 49 CFR 218.105(d) during both initial and periodic instruction required by 49 CFR 217.11. In doing so, railroads should emphasize the applicability of the rules to any area(s) where the signal system is temporarily suspended and the need to ensure and verify that all hand-operated main track switches manipulated within any suspension limits have been returned to the proper position prior to operating any trains through the limits.

7. Stress to T&E employees the importance of thorough and accurate job briefings when operating hand-operated main track switches, particularly in areas where the signal system is temporarily suspended, and specifically when releasing main track authority. Ensure adequate processes and procedures are in place enabling clear and timely communication of switch positions between and among all dispatching, T&E, and train control employees responsible for operating, performing work, or authorizing trains to operate through areas where the signal system is temporarily suspended. These processes and procedures should include processes and procedures for communicating switch position information during shift handovers. Encourage employees, in case of any doubt or uncertainty regarding the position of hand-operated switches, to immediately contact the train dispatcher or take other appropriate action to confirm the position of the switch prior to authorizing a train to operate through the limits of the area.

FRA encourages railroads to take immediate action consistent with the recommendations of this Safety Advisory and to take any other actions appropriate to help ensure the safety of the Nation's railroads. FRA may modify this Safety Advisory or take other appropriate actions necessary to ensure the highest level of safety on the Nation's railroads.

Issued in Washington, DC.

Ronald L. Batory,

Administrator.

[FR Doc. 2018-25311 Filed 11-19-18; 8:45 am]

BILLING CODE 4910-06-P

Footnotes

(1) Including 92 individuals who were transported to medical facilities for treatment and 23 people who received first aid at a triage area established near the accident site.

(2) NTSB, Safety Recommendation Report: Train Operation During Signal Suspension, Report No. RSR-18/01, Recommendation No. R-18-005 (Feb. 13, 2018), *https://www.ntsb.gov/investigations/AccidentReports/Reports/RSR1801.pdf*.

(3) On June 11, 2018, recognizing FRA's publication of the draft Safety Advisory, the NTSB classified FRA's response to Safety Recommendation R-18-005 as “Open—Unacceptable Response.” In its letter to FRA, the NTSB noted that it did not agree with FRA that “an advisory goes far enough to ensure safety.”

(4) NTSB previously closed R-12-29 after reconsideration of the recommendation noting that 49 CFR part 218, subpart F addresses the intent of the recommendation in an alternative manner.

(5) The draft Safety Advisory published on April 23, 2018, was captioned “Draft Safety Advisory 2018-01.” Subsequent to publication of the draft Safety Advisory, however, on July 27, 2018, FRA published a separate Safety Advisory addressing electrode-induced rail pitting from pressure electric welding. That Safety Advisory was numbered 2018-01. Accordingly, FRA has revised the number assigned to this Safety Advisory to 2018-02.

Attachments

View All (0)

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View document:

No documents available.

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