



**RAILROAD SIGNAL & TRAIN CONTROL GROUP
FACTUAL REPORT OF INVESTIGATION**

**Head-On Collision between
Southbound Amtrak P091-03 and
Standing CSXT Freight F777-03 near
Cayce South Carolina on
February4, 2018**

RRD 18 MR 003

(17 Pages)

**NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RAILROAD, PIPELINE & HAZ-MAT
INVESTIGATIONS WASHINGTON, D.C. 20594**

RAILROAD SIGNAL & TRAIN CONTROL – FACTUAL REPORT

A. ACCIDENT

Type: Head-on Train Collision
Date and Time: February 4, 2018 02:27:00 EST
Location: MP S367.05 Columbia Subdivision CSXT
Cayce, South Carolina
Carrier: CSX Transportation (CSXT)
Train #1: Southbound Passenger Train Amtrak P91-03
Train #2: Northbound Freight Train CSXT F77703
Fatalities: 2
Injuries: 92

B. SIGNAL & TRAIN CONTROL GROUP

James Pearl
Asst Chief Engineer Signal Construction
CSXT

Issac Boggs
Division Engineer
CSXT

Marck Michael
Service Test Engineer
CSXT

Rodrick Simpson
Asst. Div. Engineer
CSXT

Ignatios W. Thalassenos
Manager of Signals
CSXT

Ricky Lindstrom
Signal &Train Control Inspector
US Department of Transportation
Federal Railroad Administration

Cory Claypool
Grand Lodge Representative
Brotherhood of Railroad Signalmen

Timothy Purcell
Director of Engineering C&S
Amtrak

Ricky Page
Railroad Accident Investigator
NTSB Office of Railroad, Pipeline &
Hazardous Materials Investigations

Ruben Payan
Electrical Engineer
NTSB, Office of Railroad, Pipeline &
Hazardous Materials Investigations

C. SYNOPSIS

For a summary of the accident, refer to the Accident Summary Report within the docket.

D. DETAILS OF THE INVESTIGATION

D.1 Railroad Signal System

D.1.1 CSX Columbia Subdivision Signal System

The Railroad Signal System on the CSXT Columbia Subdivision (mileposts S-359.7 to S-497.2) consists of a Traffic Control System (TCS) that governs movement in both directions on the main track and signaled siding tracks. This section of rack is controlled by the FF dispatcher located in Jacksonville, Florida.

In the accident area, CSXT operates trains thru this area utilizing a TCS system in accordance with CSXT operating rule 510.¹ All train movements on controlled tracks are designated in special instructions, dispatcher message, or form EC-1. Additionally, general signal rules are in effect. Signal indication authorizes and govern train movements in either direction. On the day of the accident, the signal system was under temporary signal suspension.

The TCS system used in the vicinity of the accident includes Electro-Code 4. Electro-Code 4 utilizes DC coded track circuits to detect train positions and in effect control signals and switches. Remote controlled switches were normally operated by the dispatcher using Union Switch & Signal, M23 and M22 switch machines. Wayside signals were color light signals. Electric Lock 4 (EL4) was used in conjunction with the US&S T-21 hand throw switches equipped with derails were not controlled by the train dispatcher.

D.1.2 Planned PTC Installation

The Columbia Subdivision is planned for active Positive Train Control (PTC) in 2018. The wayside Interface Units will be in a monitoring position until the PTC system is placed in revenue service at the time of subdivision completion. The Columbia Subdivision was divided into 8 phases for PTC installation. The phase being installed was phase 7 and was

¹ **510 - Traffic Control (TC)**

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.

ongoing at the time of the accident. Phases 1 through 6 were completed. Phase 7 was completed February 6, 2018.

D.2 Post-Accident Signal Data Logs and Communication data

Data from the wayside signals was downloaded. Table 1 illustrates block occupancy by each train along with signal suspension and EC-1 authority from dispatcher.

Table -1 reflects date, time, location, and train to enter different track segment between S.E Cayce Yd. and Richland Holdout signal

Date	Time	Control Point	Event
2/3/2018	1900	All	Signal teams stop work within suspension due to hours of service laws coming into effect for employees
2/3/2018	20:09	All	F777-03 receives EC-1 authority to move south from its current location at the 362.5 holdout (S-362.5) to come down to the silica storage track (S-367.0) between S.E. Dixiana (S-366.56) and Richland Holdout (369.69)
2/3/2018	20:29:09	SE Dixiana (S 366.56)	F777-03 occupies north track circuit
2/3/2018	20:30:16	SE Dixiana (S 366.56)	F777-03 occupies OS track circuit
2/3/2018	20:30:33	SE Dixiana (S 366.56)	F777-03 occupies south track circuit (This track never indicates clear after this event)
2/3/2018	20:30:59	Richland Holdout (S 369.69)	F777-03 occupies north track circuit (This track never indicates clear after this event)
2/3/2018	20:32:10	SE Dixiana (S 366.56)	F777-03 clears north track circuit
2/3/2018	20:32:19	SE Dixiana (S 366.56)	F777-03 clears OS track circuit
2/3/2018	22:51:53	SE Dixiana (S 366.56)	F777-03 occupies OS track circuit
2/3/2018	22:52	SE Dixiana (S 366.56)	F777-03 occupies north track circuit
2/3/2018	22:56:01	SE Dixiana (S 366.56)	F777-03 clears north track circuit
2/3/2018	22:56:36	SE Dixiana (S 366.56)	F777-03 clears OS track circuit
2/4/2018	1:51:00	Silica Siding (S366.9)	F777-03 clears track warrant 93537 with dispatcher in silica storage track
2/4/2018	2:22:53	SE Cayce Yard (S 363.13)	PO91-03 occupies OS track circuit
2/4/2018	2:23:02	SE Cayce Yard (S 363.13)	PO91-03 occupies south track circuit
2/4/2018	2:26:05	NE Dixiana (S365.88)	PO91-03 occupies OS track circuit
2/4/2018	2:26:12	SE Dixiana (S 366.56)	PO91-03 occupies north track circuit
2/4/2018	2:26:45	SE Dixiana (S 366.56)	PO91-03 occupies OS track circuit
2/4/2018	2:26:56	SE Dixiana (S 366.56)	PO91-03 clears OS track circuit
2/4/2018	2:27:03	SE Dixiana (S 366.56)	PO91-03 clears north track circuit (clears later than OS due to track timer)

D.3 Dispatcher CSX CAD System Screen Shots

The newly installed electronic coded track circuits recorded track occupancy. Additionally, the electronic coded track circuits recorded switch position on the electric lock. Therefore, the CSXT CAD was able to record those events through the indication of track occupancy.

The CSXT CAD dispatcher system is not an actual recording of events. Rather it is a regenerated view of the actual events timeline. On February 20, 2018, a simulated test was performed by CSXT personnel with train shunts and the hand throwing of switches to replicate the events that took place on the accident date beginning with the CSXT train F777-03 leaving the S.E Cayce, MP (S-363.2). This event was filmed and recorded in Jacksonville, Florida to ensure that the regenerated CAD view did in fact replicate track occupancy as the CAD system did on the day of the accident. NTSB investigators were on hand along with other party members to observe and verify that the track occupancy lights performed the same as on the day of the accident. A copy of the simulated test can be found in the public docket. However, the time may be off due to latency or because it is a regenerated view and not an actual recording of events. The following screen shots are from the CSX CAD System Screen shots on the day of the accident beginning with CSXT train F777-03 occupying track between S.E. Cayce Yard and S.E. Dixiana.

**1. CSX: 2/3/18 Cayce, SC Train Incident - CAD Log F77703
2029_16 This exhibit reflects F77703 occupying tracks between S.E.
Cayce Yard and S.E. Dixiana. Also depicting the track south of S.E.
Dixiana as unoccupied.**

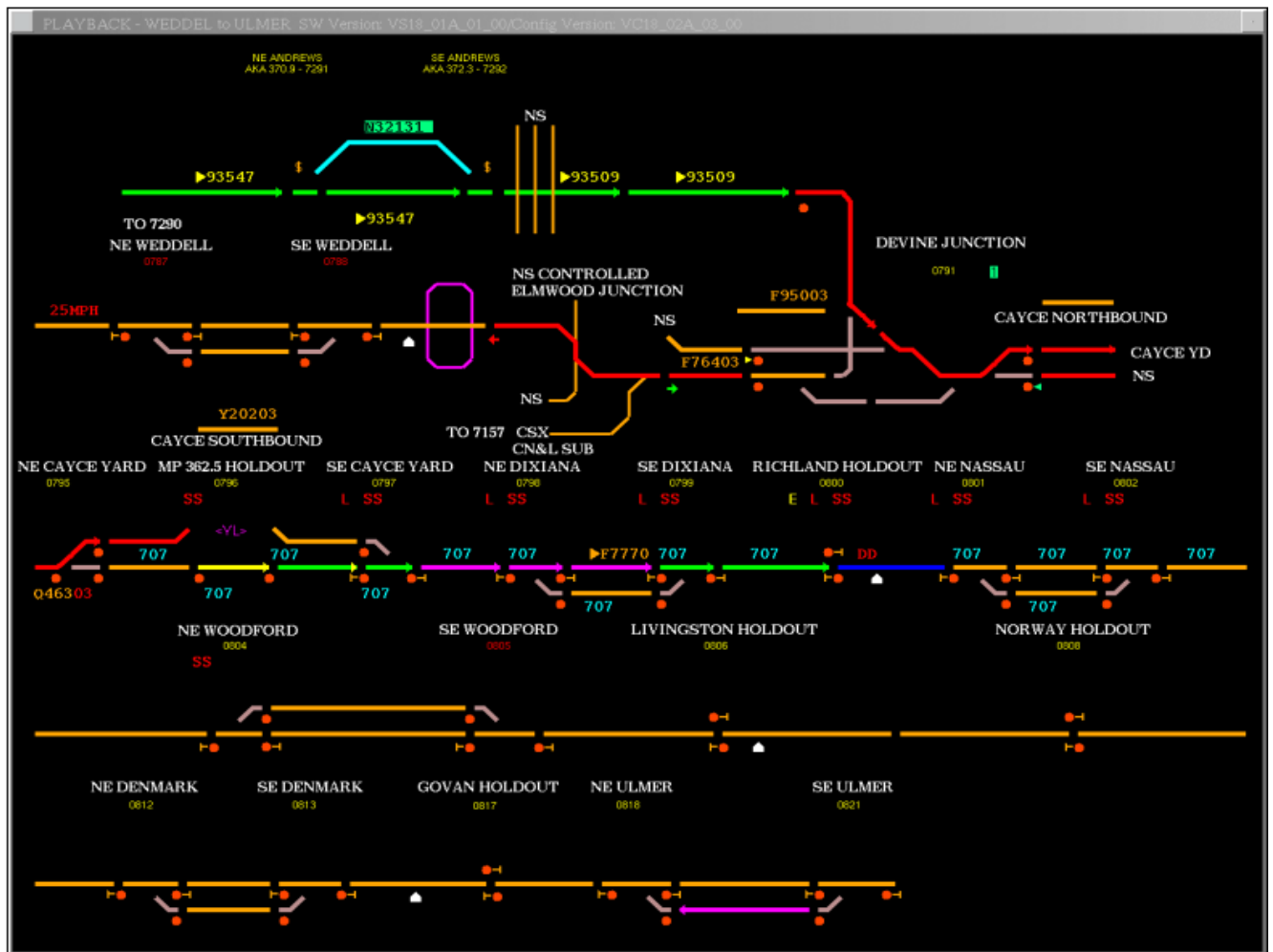


Figure 1 depicts Train F777-03 occupying track segments between S.E. Cayce Yard and S.E. Dixiana.

2. CSX: 2/3/18 Cayce, SC Train Incident - CAD Log F77703
 2030_17 screen shot depicts F77703 in the OS track of S.E. Dixiana
 with south track still reflecting unoccupied.

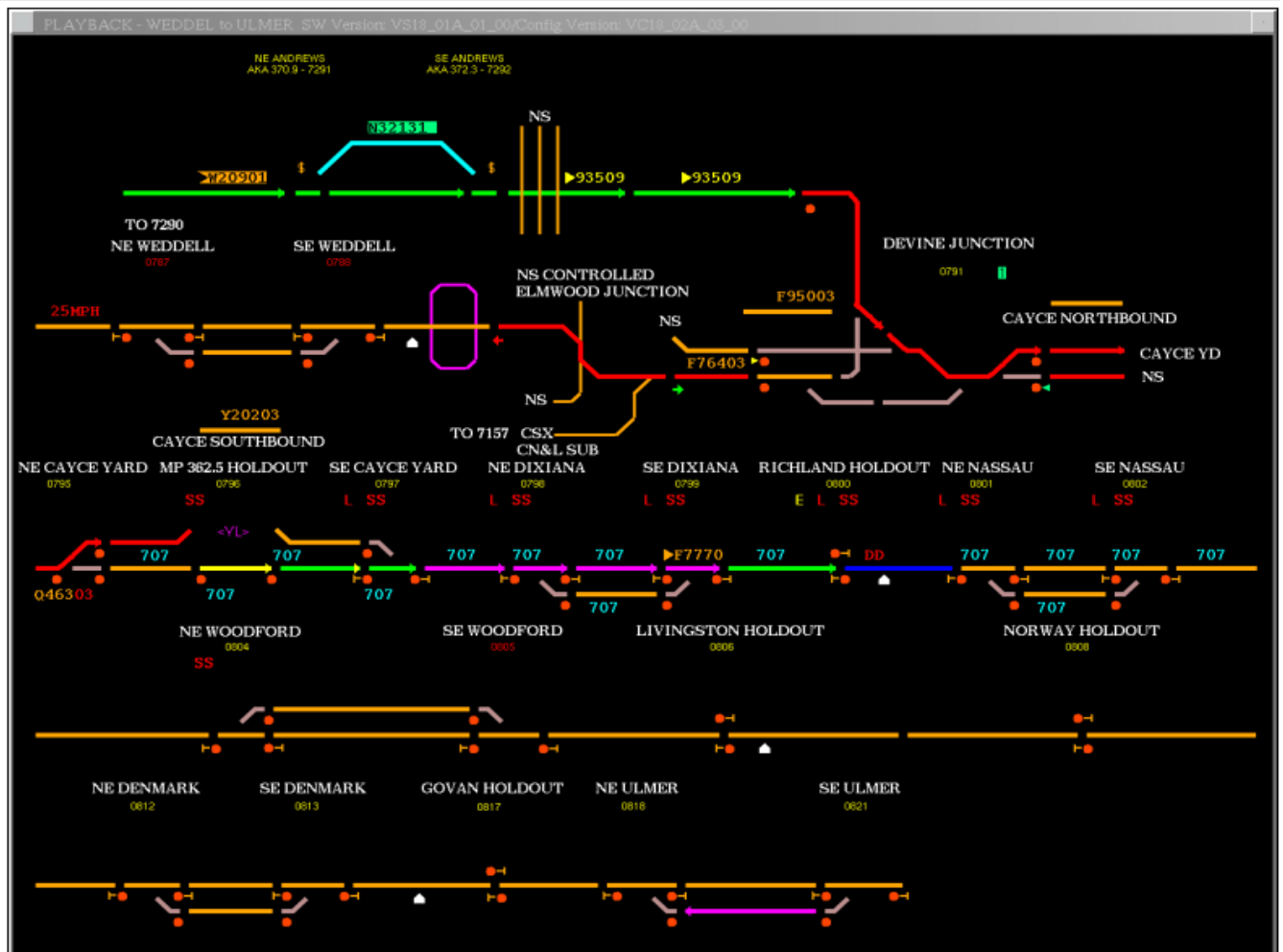


Figure 2 depicts train F777-03 entering OS track at the CP S.E. Dixiana while the south track where derailment occurred is unoccupied!

3. CSX: 2/3/18 Cayce, SC Train Incident - CAD Log F77703
 2031_00 screen shot reflecting F77703 occupying tracks between N.E. Dixiana and Richland Holdout Signal. The track between Richland Holdout and the S.E. Dixiana does not show unoccupied after this point.

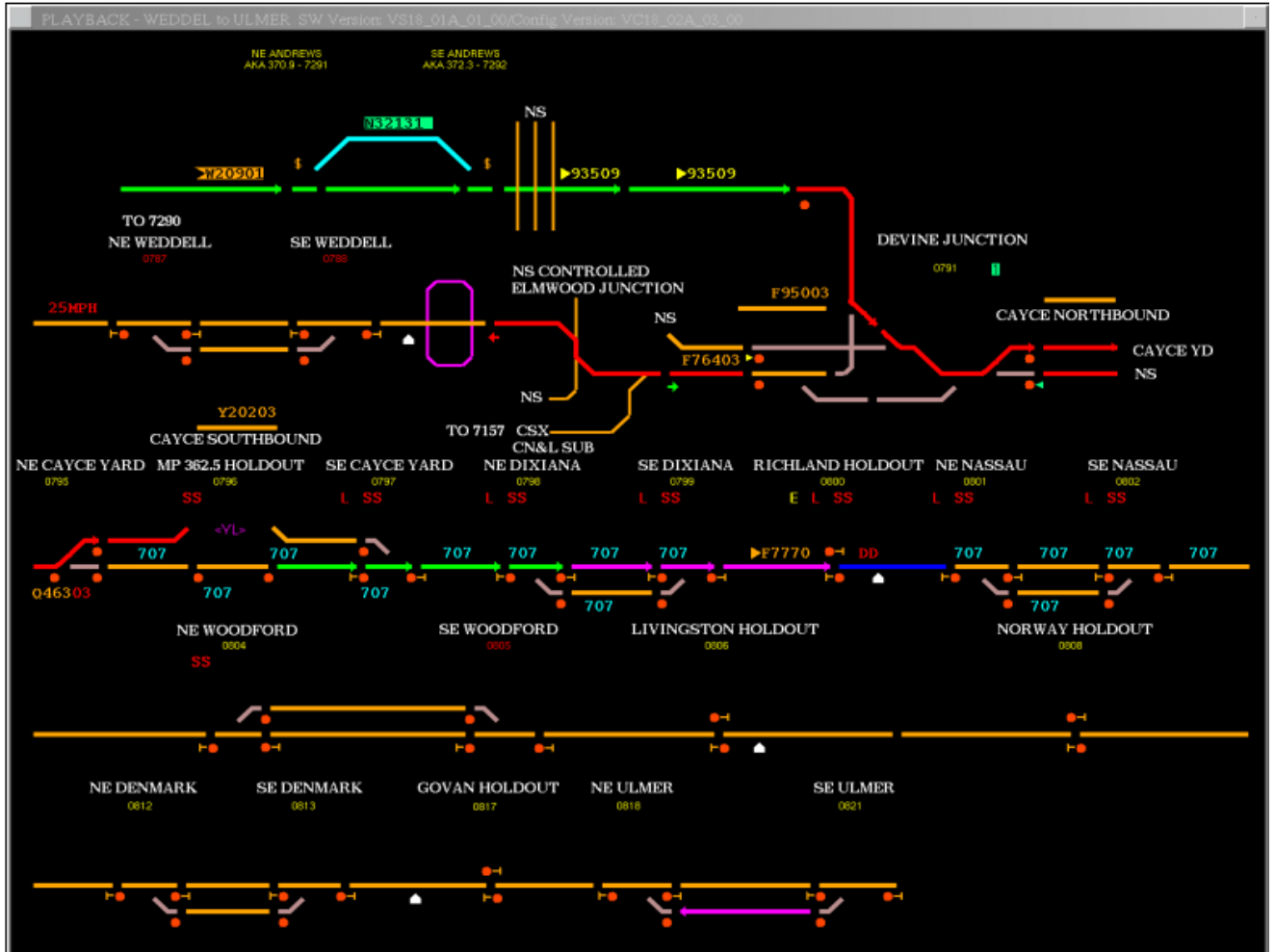


Figure 3 depicts train F777-03 occupying tracks between N.E. Dixiana and the track south of the S.E. Dixiana.

4. CSX: 2/4/18 Cayce, SC Train Incident - CAD Log F77703
 0151_00 reflects F77703 only occupying the track between S.E
 Dixiana and Richland Holdout.

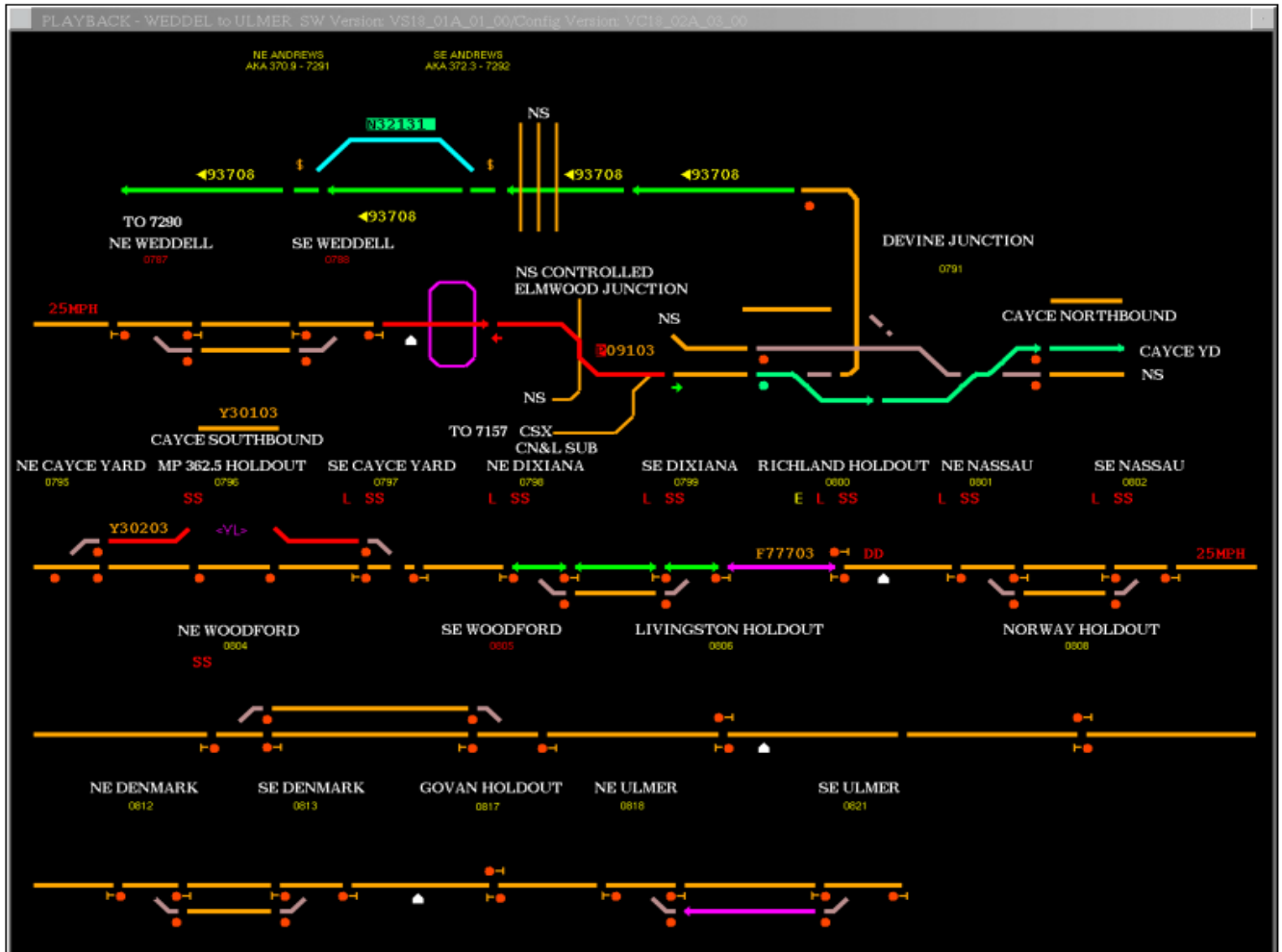


Figure 4 depicts train F777-03 only occupying the track segment where collision occurred.

5. CSX: 2/4/18 Cayce, SC Train Incident - CAD Log P09103
 0222_53 reflects P091-03 occupying OS at the S.E. Cayce Yard and
 the track between S.E. Dixiana and Richland Holdout is still showing
 occupied without train designation.

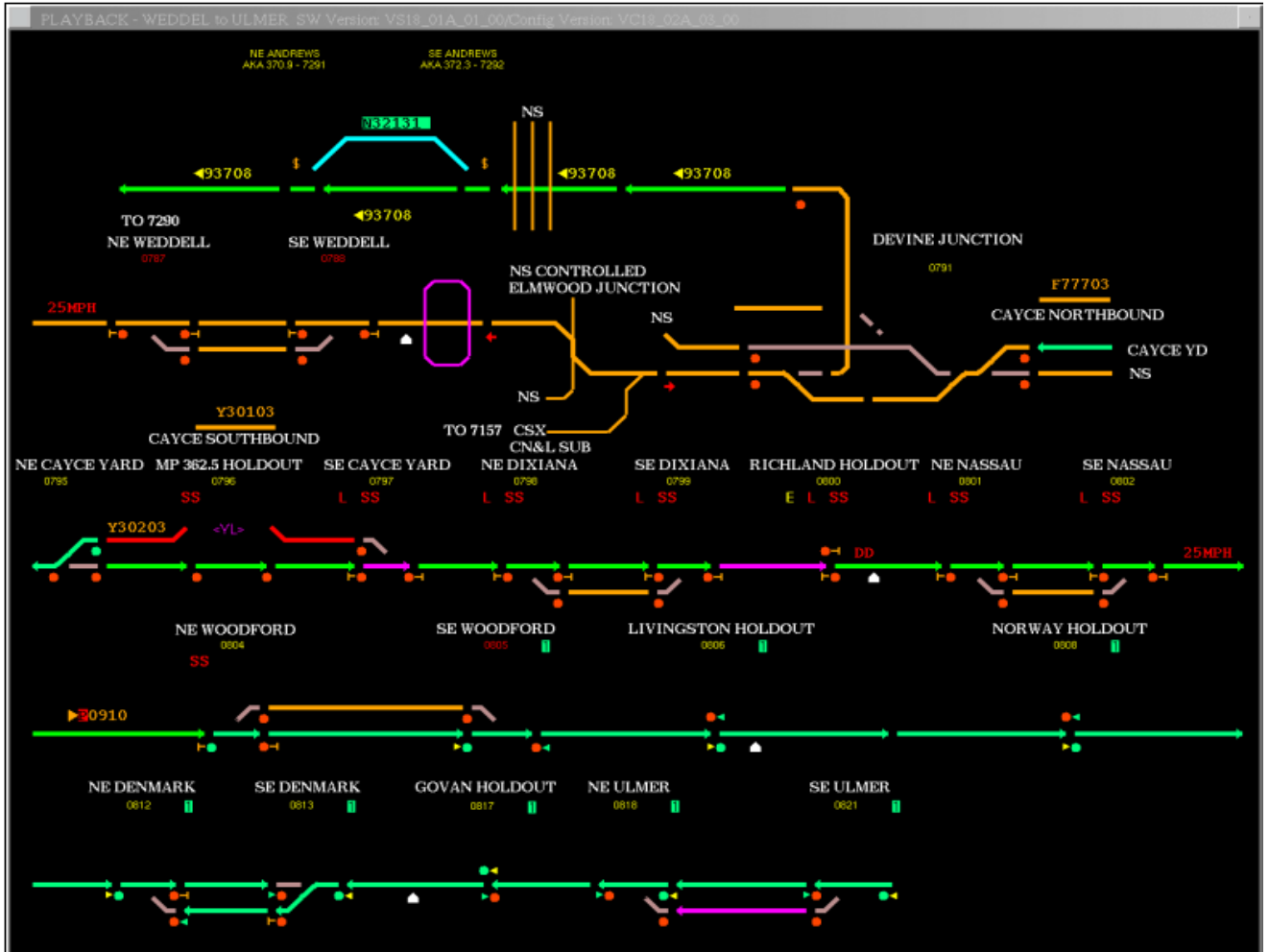


Figure 5 depicts train P091-03 entering the OS track at the S.E. Cayce yard while the track segment where collision occurred is still reflecting occupied without train designation.

6. CSX: 2/4/18 Cayce, SC Train Incident - CAD Log P09103
 0223_02 reflects train P091-03 occupying S.E. Cayce Yard and N.E. Dixiana.

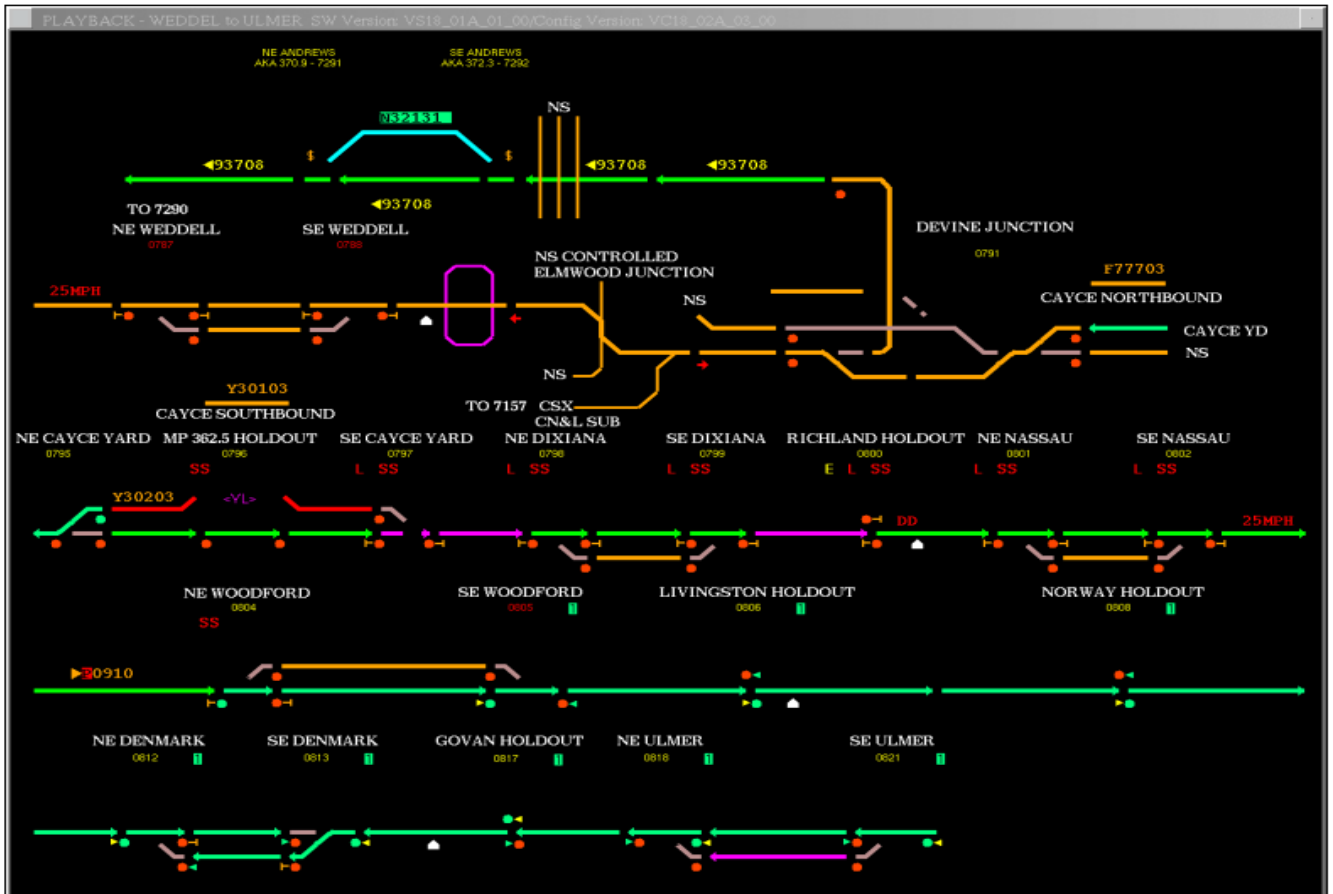


Figure 6 depicts train P091-03 occupying tracks in the OS at S.E. Cayce Yard and the north track at N.E. Dixiana

7. CSX: 2/4/18 Cayce, SC Train Incident - CAD Log P09103
0226_05 reflects P091-03 entering N.E. Dixiana with the track south of of
S.E. Dixiana still occupied.

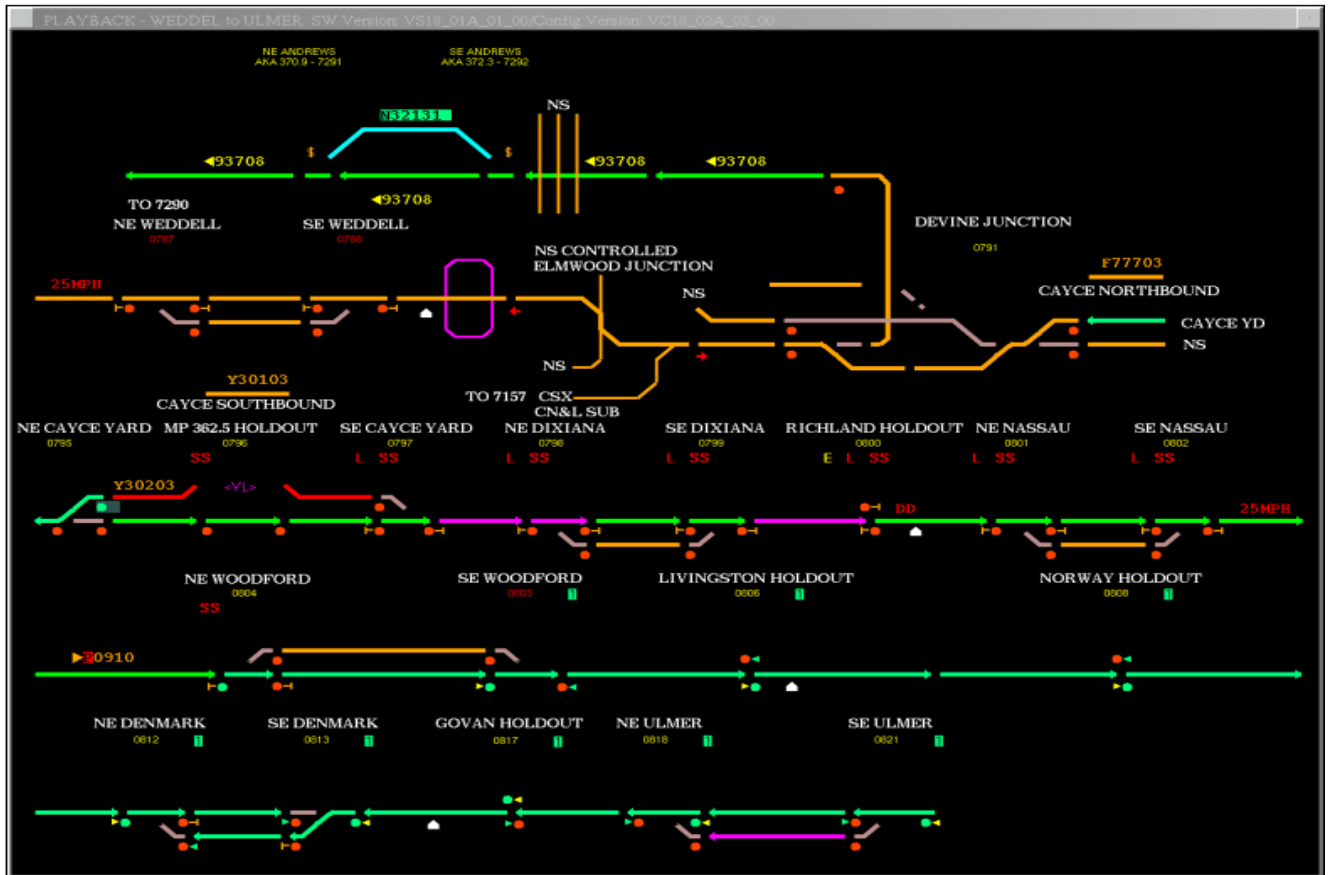


Figure 7 depicts train P091-03 entering the OS at the N.E. Dixiana with the track segment at silica storage track still indicating occupied.

8. CSX: 2/4/18 Cayce, SC Train Incident - CAD Log P09103 0226_56 reflects P091-03 entering S.E. Dixiana OS Track with the track south of S.E. Dixiana still occupied.

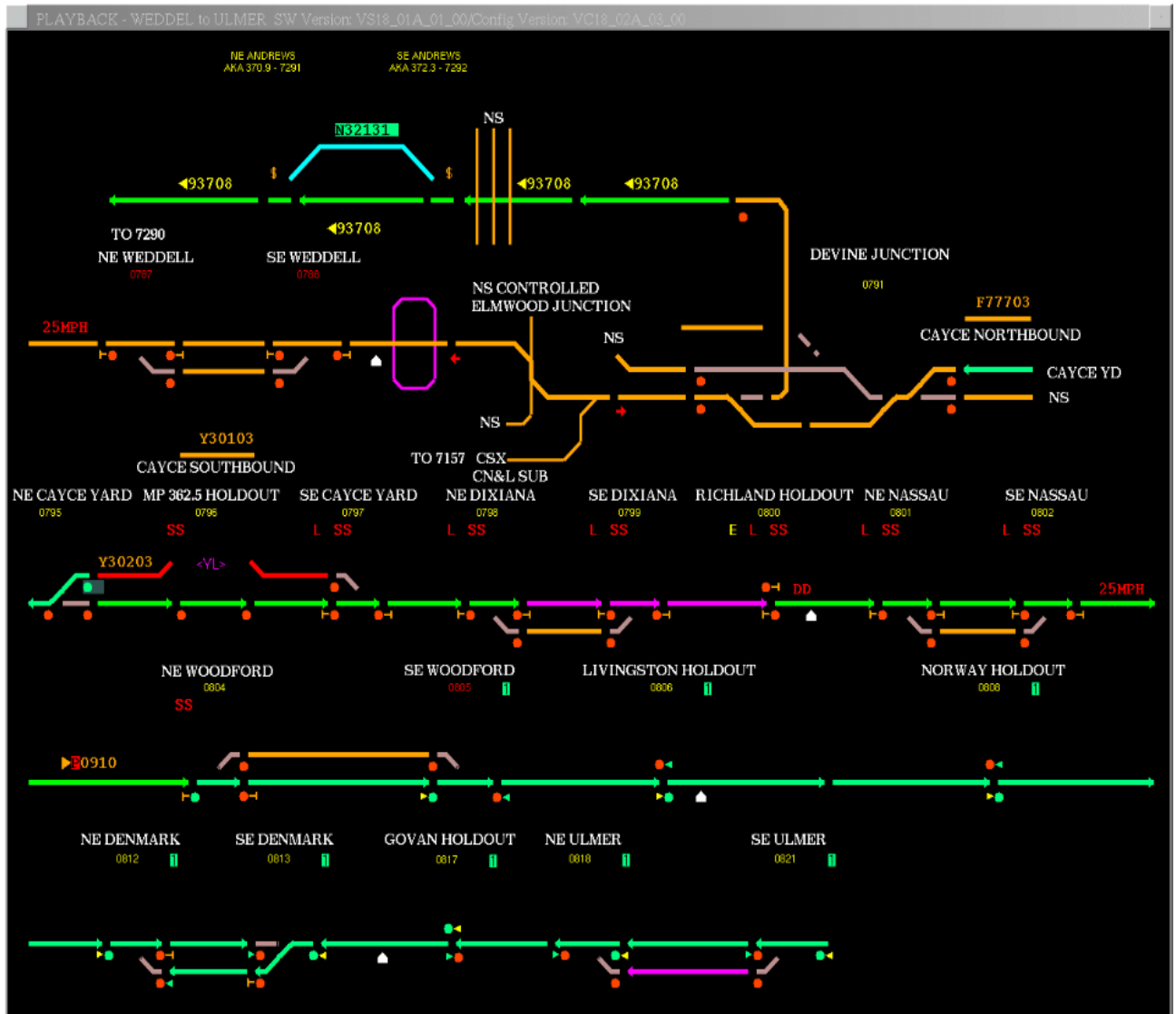


Figure 8 depicts train P091-03 entering S.E. Dixiana OS track with track segment at silica storage track still indicating occupied.

D.4 The Temporary Signal Suspension

On the day prior to the accident there was a temporary signal suspension in place that began at 7:30 am on Saturday February 3, 2018. The reason for the signal suspension was for modifications made to the signal system in relation to the implementation of PTC. The temporary signal suspension was proposed to and accepted by CSXT transportation officers to install electronic track circuits, frame communications circuits, PTC compatible

microprocessor based vital logic controllers and replace signals in relation to the implementation of PTC. In a letter dated January 8, 2016 and labeled as exhibit S-7 in the public docket from CSXT to the Federal Railroad Administration, FRA regional administrator Carmen Patriarca, CSXT stated, “this arrangement would have no adverse effect on train operations and has been approved by transportation and operating departments.” In an interview conducted by NTSB personnel, CSXT Service Test Engineer Marck Michael stated the temporary signal suspension would be in effect for about one and half days, “It was planned. The suspension was supposed to take approximately a day and a half. I had authorization to do it through about two days,” (Pg. 7 ln 21-23). The signal system had been suspended at 7:23am on February 3, 2018. According to testimony given by Jason Schroeder, CSXT, Director Service Test Engineering, the signal department had 43 signal contract personnel, and 5 CSXT managers on hand to assist with the signal cut-over during the signal suspension. Additionally, CSXT used a contractor to serve as a liaison to the operating dept at the dispatching office. During the signal cut-over, trains entered the limits of the temporary signal suspension three times while CSXT signal personnel were trying to complete the cut-over. The CSXT Service Test Engineer stated that train movements totaled about six hours inside the temporary signal suspension limits. On February 6, 2018 the signal cut-over was completed over about a 2-hour period and the temporary signal suspension was lifted. CSXT operating rule 504.35 states the conditions which warrant temporary signal suspensions;

OR 504.35 *Remove signals from service only when authorized by the proper authority and in the following circumstances:*

- a. *Storm or flood renders signal system inoperative, or***
- b. *Prompt restoration of signal system disruption for other cause(s) cannot be effected, or***
- c. *Construction work necessitates the signals' temporary removal from service.***

Operating rule 504.36 states how the signal system maybe temporarily removed from service and states to use an alternate method of operation;

OR 504.36 *Special instructions, dispatcher message, or Form EC-1 may temporarily remove block signals and signal rules from service. When signal system is suspended, establish an alternate method of operation and notify all trains affected.*

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 505.² The maximum authorized speed under TWC-D was 59 MPH for passenger trains and 49 MPH for freight trains. The EC-1 form was used to control train movements from the southward holdout signal located at MP 362.5 to the SAS NE Woodford at MP S-385.01. Electric Lock 4 (EL4) and ElectrologIXS were being installed for PTC to detect train occupancy and affect signals and switches. The installation of the ElectrologIXS coded track circuits had been completed, were operating properly and were recording data in the block between the S.E. Cayce and the Richland holdout signal. Thus, creating track occupancy lights with train movement within this affected block on the FF dispatcher's screen at Jacksonville FL. However, the dispatcher was instructed to disregard the track occupancy lights during the signal system suspension and while the method of operation was TWC-D OR 505.

Regulatory oversight by the Federal Railroad Administration does not require separate approval of temporary signal suspensions if they are a necessary component of a signal system modification or to perform maintenance or needed repairs. NTSB submitted a questionnaire to the FRA on March 21, 2018 to clarify and interpret the legal definition of the Code of Federal Regulations regarding temporary signal suspensions. In the FRA response to the questionnaire, the FRA stated, "FRA does not require separate approval of temporary signal suspensions if they are a necessary component of a signal system modification. In addition, FRA does not require approval of temporary signal suspensions needed to perform required maintenance or repairs to the system – with the exception of signal systems temporarily removed from service for a significant period of time (i.e., over six months) in response to a catastrophic occurrence such as derailment, flood, fire, or hurricane (see 49 CFR § 235.7(a)(4)). During the course of routine rail operations, railroads may need to temporarily suspend operation of a signal system to perform required maintenance or needed repairs to the system. In these instances, railroads are not required to obtain FRA approval before they temporarily suspend the signal system. Similarly, a railroad may need to temporarily suspend its signal system to install new components for

² **505 - Track Warrant Control Non-Signaled (TWC-D)**

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.

an existing signal system or to install a new signal system. Generally, railroads limit the duration and scope of temporary signal suspensions in these instances and have operating rules and practices in place governing rail operations when temporary signal suspensions are in effect. In these situations, a railroad may be required to obtain prior FRA approval of the signal system modification under 49 CFR § 235.5(a)(3). However, FRA would not require the railroad to seek separate FRA approval of any temporary signal system suspension required to carry out the overall modification.” In an interview with FRA region 3 Signal & Train Control Specialist on April 17, 2018 in Atlanta Georgia, the S&TC specialists testified that, “Signal suspensions take place probably on a daily basis. I mean, a signal suspension could be a -- like this one here, which was just over 20 miles for a PTC installation. It could be as small as just putting a signal into service. It could be, you know, signal trouble on the railroad where they have to take a control point out of service or something to work. But signal suspensions are a common thing all over the industry.”

D.4 Highway Grade Crossing Warning System

In this area of the CSXT, Columbia Subdivision one highway-rail grade crossing warning system is in use. This highway/rail grade crossing warning system is located at MP S-366.57, north of the point of collision and operated properly at the time train PO9103 was passing the location. This warning systems is controlled by a General Electric PMD-3 57-CWU-1, grade crossing motion detector. The data log from the highway/rail grade crossing warning system was downloaded. Table 2 summarizes the data from the highway-rail grade crossing warning device.

Location	Train	Warning Time
MP S-366.57 Dixiana Road DOT # 634693B	PO9103	39 seconds

E Post-Accident Signal System Examination and Testing

The post-accident inspection found all signal equipment secured with no indications of tampering or vandalism.

Signal aspects were verified, shunt tests, ground tests and operational tests of the signal system were completed. An accident simulation using testing equipment and local control of the control points was conducted to ensure signal system integrity. The signal aspects of that test were photographed and recorded. No exceptions were taken with the post-accident examination or testing.

Post-accident inspection of the switch located at S 366.9 was completed. There was no damage to the T-21 switch with electric lock. Switch was found to be in the reverse position, with a pad lock in the latch stand and the bayonet in the foot pedal. The derail in conjunction with the switch had damage to the connecting rod being bent, derail being broken, and wires being pulled out of junction box and broken. Switch was found to be working as intended.

There were no defects noted during the examination of the signal system or the associated signal appurtenances.

F. Interviews

Five Interviews were conducted by the NTSB signal group with the FRA Signal Specialist Region 3, CSXT Communication & Signals Chief Engineer, Director Service Test Engineering, Signal Service Test Engineer, and a contractor liaison. All five interviews have been placed in the public docket.

G. CSXT Signal System Trouble/Remedy Tickets

Signal system trouble/remedy tickets logged by the Network Operations Center for the Signal Block between the S.E. Cayce Yard and the Richland Holdout CP have been received and reviewed. Records do not reflect any FRA violations nor any connection with this accident.

H. CSXT Railroad Maintenance Records

Railroad maintenance, inspection and tests records for signal locations for the signal block between the S.E. Cayce Yard and the Richland Holdout CP have been received and reviewed. Records do not reflect any FRA violations nor any connection with this accident.

I. Damages

Total cost of signal damage to the hand throw switch and derail with electric lock located at the Silica storage track (MP 366.9) is estimated at \$1,300.00.

END OF SIGNAL AND TRAIN CONTROL FACTUAL REPORT