National Transportation Safety Board

Office of Railroad, Pipeline, and Hazardous Materials Investigations
Washington, D.C. 20594

Factual Report of Investigation – Railroad Signal & Train Control Group

Rear-End Collision of
CSX Transportation Trains
Q194-23 and Q618-22 at
Mineral Springs, North Carolina on
May 24, 2011

A. EVENT

Location:	Mineral Springs, NC, milepost SG 314.2
Date:	May 24, 2011
Time:	3:35 a.m. eastern standard time (EST)[1]
Carrier:	CSX Transportation
Trains:	Northbound Freight Train Q618 -22
	Northbound Freight Train Q194-23

B. GROUP

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C. SUMMARY

On May 24, 2011, at about 3:35 a.m., eastern daylight time, northbound CSX Transportation, Monroe Subdivision train Q194-23, struck the rear of northbound CSX Transportation train Q618-22, which had stopped at signal SG 314.0. The accident occurred in Mineral Springs, North Carolina, approximately eight miles south of the CSXT Monroe Yard. The striking train Q194-23 consisted of 12 intermodal cars and the struck train Q618-22 consisted of nine general manifest cars. Each train had two crewmembers—a train engineer and train conductor both located in the control cab of the lead locomotive. The engineer and conductor of the striking train were killed; the conductor and engineer of the struck train had minor injuries. The accident resulted in a fire of the two Q194-23 locomotives and also included an equipment fire of the striking train. There were no hazardous materials in either trains consist. Total monetary damages were estimated at about $1.6 million.

D. DETAILS OF THE INVESTIGATION

Description of Railroad Signal System:

The CSX Florence Division, Monroe Subdivision runs in a timetable north-south direction between North End of Pee Dee at milepost (MP) SF 264.9 in Pee Dee, NC and

[1] All time is eastern standard time unless otherwise noted.

South End of Abbeville at MP SG 441.9 in Abbeville, SC. The maximum timetable[2] authorized speed for trains operating in the vicinity of the accident is 50 mph for freight trains.

Train movements on the CSX Monroe Subdivision are governed by operating rules, timetable instructions and the signal indications of a traffic control signal (TCS) system. The "FC" train dispatcher located at the CSX Florence Division Operations Center coordinates train movements with the signal system on the CSX Monroe Subdivision. Between CP North End of Waxhaw and CP South End of Monroe, the CSX TCS system utilizes coded track circuits and colorlight type signals (approximately 12.2 miles).

CSX Operations Center Logs:

Postaccident data was downloaded from the Ansaldo Computer Aided Dispatch (CAD) System logs at the CSX Florence Division Operations Center. Table 1 summarizes signal and train control events recorded between Control Point (CP) North End of Waxhaw and CP South End of Monroe on the data log.

Table 1 *Recorded events from CSX Operations Center logs.*

Time[3]	Location	Event
2:06:42	NE Waxhaw	Dispatcher requests signal clear
2:08:33	NE Waxhaw	Signal indicates clear indication
2:58:01	SE Monroe	Dispatcher requests switch normal Switch indicates normal indication
2:58:03	SE Monroe	Dispatcher requests signal clear Signal indicates clear indication
2:58:04	SE Monroe	Switch indicates out-of-correspondence
2:58:19	SE Monroe	Switch indicates normal indication System requests signal clear (stacked request)
2:58:24	SE Monroe	Signal indicates clear indication OS track circuit indicates occupied
3:00:11	SE Monroe	OS track circuit indicates unoccupied
3:03:35	NE Waxhaw	OS track circuit indicates occupied by northbound Train Q616-23 Signal indicates stop indication
3:03:50	NE Waxhaw	OS track circuit indicates unoccupied by Train Q616-23 Block between SE Monroe and NE Waxhaw indicates occupied by Train Q616-23
3:07:48	NE Waxhaw	Dispatcher requests signal clear (follow-up move)
3:13:23	NE Waxhaw	Signal indicates clear indication
3:15:10	NE Waxhaw	OS track circuit indicates occupied by northbound Train Q618-22 Signal indicates stop indication

[2] CSX, Florence Division Timetable No. 6, effective Thursday July 1, 2010
[3] Time based on CSXT Florence Division Operations Center system clock.

3:15:49	NE Waxhaw	OS track circuit indicates unoccupied by Train Q618-22 Block between SE Monroe and NE Waxhaw indicates occupied by Train Q618-22
3:15:54	NE Waxhaw	Dispatcher requests signal clear
3:20:25	NE Waxhaw	Signal indicates clear indication
3:26:54	NE Waxhaw	OS track circuit indicates occupied by Train Q194-23 Signal indicates stop indication
3:28:20	NE Waxhaw	OS track circuit indicates unoccupied by Train Q194-23 Block between SE Monroe and NE Waxhaw indicates occupied by Train Q194-23
3:31:57	SE Monroe	OS track circuit indicates occupied by Train Q616-23 Signal indicates stop indication
3:32:05	SE Monroe	OS track circuit indicates unoccupied by Train Q616-23 Block between SE Monroe and NE Monroe indicates occupied by Train Q616-23

Recorded radio logs from the CSX Florence Division Operations Center and field personnel were reviewed. Table 2 summarizes events recorded on the radio logs.

Table 2 *CSX Operations Center radio communication log.*

Time[4]	**Event**
3:19	Train Q697-24 stopped at Marshville waiting for arrival of Train Q696-21.
3:35	Train Q697-24 given permission to advance past signal at SE Marshville into block between Marshville and Richardson Creek.
3:40	Smoke and fire at rear of train reported by Train Q618-22

Postaccident Inspection/Testing of Signal System:

On May 24, 2011, representatives from CSX and the Federal Railroad Administration began conducting a field inspection and investigation of the railroad signal system and the SG 316.0 automatic signal location. The postaccident inspection found all signal units, switches, and the signal cases, at the intermediate signals, SE Monroe and at NE Waxhaw, locked and secured with no indications of tampering or vandalism to any of the signal equipment. Observation of the SG 316.0 red aspect revealed that it was dark. Further testing disclosed the signal cable from the case to the 316.0 red aspect was energized. This indicated that the signal lamp bulb for the red aspect was burnt out.

On May 25, 2011, representatives from CSX, Federal Railroad Administration, Brotherhood of Railroad Signalmen, North Carolina Department of Transportation and NTSB began conducting a field inspection and investigation of the railroad signal system. All relay positions were found to be in accordance with the physical location of the accident trains and with the displayed signal aspects. Ground tests were performed and all track circuits were verified. On the CSX Monroe Subdivision, 10 volt, 18 watt lamps are installed in the signal heads. The colorlight signals were inspected and lamp operating

[4] Time based on CSXT Florence Division Operations Center system clock.

voltages were measured. Table 3 contains the lamp voltage readings for the SG 316.0 signal. The lamps were found to illuminate properly with the exception of the automatic signal 316.0 red aspect which was dark. Signal 316.0 was configured to be constantly lit for northbound train movements and Signal 316.1 was approach lit for southbound train movements.

Table 3. *Signal SG 316.0 lamp voltages.*

Signal Aspect	**Voltage**[5]
Red	13.05 V (dark signal)
Yellow	11.4 V
Green	11.3 V

Track connections and insulated joints were inspected and no exceptions were noted. No terrain or physical structures were found to impede the preview to the northbound home signals at NE of Waxhaw or at automatic signal SG 316.0. Complete operational test where conducted for a northward train movement with following moves up to and including the SG 313.7 automatic signal. Insulation resistance tests for all cable at the NE of Waxhaw, the SG 316.0/316.1 signals and the SG 313.7/313.8 signals were conducted. All relays at the NE of Waxhaw, the SG 316.0/316.1 signals and the SG 313.7/313.8 signals, were tested for operating specifications and no exceptions were noted.

On May 27, 2011, the cable for the SG 316.0 signal lighting circuit was again tested for insulation resistance. All case wire for the SG 316.0 signal lighting circuit was verified. All involved relays contact and mounting blocks in the lighting circuit of the SG 316.0 were tested and verified. Flex wire from the SG 316.0 signal base into the mast and up to the signal lamps was removed, inspected and replaced with new flex wire. No exceptions were noted with the condition of the flex wire.

The investigation determined that the circuit plans at the SG 313.7/313.8 signal case were incorrect and did not include all signal equipment that was installed at that location. No other exception where noted.

CSXT Train Control Incident System Reports:

Signal incident reports logged by CSX Electronic Signal Specialists (ESS) located at the CSX Florence Division Operations Center were reviewed by the signal investigation group. Table 4 summarizes the train control incident reports logged between control point NE of Waxhaw and control point SE of Monroe for one year period prior to the accident.

[5] Voltage measurements were taken at the junction box located at the base of the signal mast.

Table 4. *Train control incident reports.*

Date	Report Description	Identified Condition
6/13/10	Track occupancy light (TOL) between SE Monroe and NE Waxhaw	Issue cleared before cause identified, unable to duplicate
6/14/10	TOL left behind train Q675-13	Track circuit cleared
7/8/10	FC Dispatcher reported TOL	RTR relay replaced at MP SG 313.7
7/12/10	TOL left by train Q614-09	Shorted lightning arrestors replaced at 311 signal and 313.7 signal
7/12/10	Dispatcher reports TOL which dropped signal on northbound train Q194-11	Issue cleared before cause identified, unable to duplicate
7/27/10	Dispatcher had 2 southbound trains report red signal at Mineral Springs	Issue cleared before cause identified, unable to duplicate
8/19/10	Dispatcher reports TOL left behind northbound train	Maintainer replaced damaged trans-orb at signal 313.7
8/22/10	TOL between Monroe and Waxhaw	#2 contact bad in LTR relay, maintainer replaced RTR and LTR relays
8/30/10	Train Q675-30 reports signal SG 313.8 dark at Mineral Springs	Maintainer reports bulb adaptor not properly seated in socket, repared
9/3/10	Southbound train Q699-03 reported signal MP SG308.6 cycling from green to yellow to red	Insulated joint end post replaced at SG 313.7 east rail
9/27/10	Dispatcher reported TOL between Monroe and Waxhaw	Bad contact on RCTPR relay at SG 313.7
12/3/10	Dispatcher reports TOL between Monroe and Waxhaw	Maintainer released RTR relay at MP SG 313.7
12/5/10	TOL left after train Q616-04 between Waxhaw and Monroe	RTR relay at signal 313 replaced due to burned/stuck contacts
12/15/10	Train F761-15 reports SG 313 signal cycling and signal SG 316 all red	Replaced bad insulated joint at MP 316
1/1/11	Dispatcher reports TOL behind northbound train Q614-30	Maintainer changed out RTR relay at MP 313.8
1/19/11	TOL on by itself between Monroe and Waxhaw	Dispatcher informed that trainmaster was doing tests on trains
1/23/11	Track circuit pumped ahead of train Q667-23 with a restricted proceed at MP 308.5	Issue cleared while testing
1/30/11	Southbound signal at SE Monroe dropped on train	Maintainer changed out RTR relay at SG 308 signal due to high resistance contact.

2/16/11	TOL on and off between Monroe and Waxhaw	LTR relay at SG 318 signal had #4 contact burned, and RCTPR relay at signal 316 no seated
4/23/11	TOL left behind Q194-24, train crew reports intermediate dark at SG 316.0	Maintainer replaced RTR relay at 313.7
5/19/11	TOL	Circuit cleared before arrival
5/20/11	Dispatcher reports northbound train F762-20 had a red at SG313.5 and a dark at SG 316	Maintainer reported the circuits cleared on arrival, track circuit was adjusted at 313.7 and watched a northbound train

Further investigation into the two reported dark signal incidents at SG 316.0 (4-25-11 and 5-20-11) determined that on both incidents, a signal maintainer was called out for the reported signal condition that consisted of the SG 313.7 signal displaying a red aspect and the SG 316.0 signal being dark. Voice tapes of the telephone calls between the ESS and the signal maintainers regarding the two incidents were reviewed. On both occasions, the ESS informed the maintainers about the red signal at 313.7 and the dark signal at 316.0. During postaccident discussions between the involved maintainers and investigators, both maintainers could not recall whether they were informed about the dark signal at 316.0. The train control incident reports regarding the two signal conditions indicated that the reported track occupancy light was resolved and trains were observed operating through the area to verify the repairs, but did not contain any information about either maintainer addressing the dark signal reported at signal SG 316.0.

Damages

The CSXT signal system did not sustain any damage to the signal equipment and appurtenances as a result of the train collision. Repair damages to track connections and bonding were necessary to restore track circuits following wrecking operations.

END OF FACTUAL REPORT