**National Transportation Safety Board**
Office of Railroad, Pipeline and Hazardous Materials Investigations
Human Performance and Survival Factors Division
Washington, D.C. 20594

# HUMAN PERFORMANCE GROUP CHAIRMAN'S FACTUAL REPORT

## A. ACCIDENT

**Location**: Mineral Springs, North Carolina
MP 314.2
**Carrier:** CSX Transportation
**Trains:** CSX Transportation trains Q19423 and Q61822
**Date:** May 24, 2011
**Time:** About 3:35 a.m.
**Number:** DCA-11-FR-004

## B. HUMAN PERFORMANCE GROUP

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## C. SUMMARY OF THE ACCIDENT

On May 24, 2011, at about 3:35 a.m., eastern daylight time, northbound CSX Transportation Monroe Subdivision train Q19423, struck the rear of northbound CSX Transportation train Q61822, which had stopped at SG 314.0. The accident occurred in Mineral Springs, North Carolina, approximately eight miles south of the CSXT Monroe Yard. The striking train Q19423 consisted of 12 intermodal cars and the struck train Q61822 consisted of nine general manifest cars. Each train had two crewmembers—a train engineer and train conductor both located at the front of the lead locomotive. The engineer and conductor of the striking train were killed; the conductor and engineer of the struck train incurred minor injuries. The accident resulted in a fire of the two Q19423 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

### 1. Behavioral Factors

Work/ Rest

Train Q19423[1]

The engineer went on duty on Monday May 23, 2011 at 9:45 p.m. and operated his train until the time of the accident (3:35 a.m. on May 24, 2011). He had been off duty for 16 hrs 40 min. On Sunday May 22, 2011 he had worked from 6:00 p.m. until 5:05 a.m. May 23, 2011. On Saturday May 21 he worked from 10:30 a.m. to 3:50 p.m. He was off duty on May 19 and May 20. On May 18 he worked from 0500 to 1410, after having been off duty for 10 hrs 25 minutes.

The conductor went on duty Monday May 23, 2011 at 9:45 p.m. and worked until the time of the accident. He had been off duty for several days prior to that. He had worked on May 16, 2011 from 5:00 p.m. to 03:10 a.m. May 17, 2011.

Train Q61822

The engineer was contacted by CSX on Monday May 23, 2011 about 8:30 p.m. to report for work in 2 hours. He went on duty at 10:30 p.m., and operated his train until the time of the

[1] The human performance group was unable to collect detailed information about the off-duty activities of the engineer and conductor of train Q19423.

accident. He had been off duty for 14 hrs and 15 minutes. On May 23, 2011 he also worked from 1:30 a.m. to 8:15 a.m. after having been off duty for 18 hours 43 minutes. On Saturday May 21, he went on duty at 11:00 p.m. and worked until 6:47 a.m. May 22. On Friday May 20, he went on duty at 7:45 p.m. and went off duty at 2:40 a.m. on May 21.

The conductor was contacted by CSX on Monday May 23, 2011 about 8:30 p.m. to report for work in 2 hours. He went on duty at 10:30 p.m., and worked with the engineer until the time of the accident. He told investigators that he "felt fine" at the start of his shift. He had been off duty for 87 hrs and 17 min. He spent his off duty time with his family and resting. Prior to that he had last worked on May 19, 2011 from 10:00 p.m. to 7:13 a.m. on May 20, 2011.

## 2. Medical Factors

*a.* Health

Train Q19423

The CSX medical records for the engineer of train Q19423 indicated that his last hearing and vision tests were on May 22, 2009. The results indicated that his vision and hearing were normal. No medical conditions or medications were mentioned in these records.

The CSX medical records for the conductor of train Q19423 indicated that his last hearing and vision tests were on September 16, 2009. The results indicated that his vision and hearing were normal. No medical conditions or medications were mentioned in these records.

Train Q61822

The engineer and conductor on train Q61822 told investigators that they were in good health when they went on duty on the night of the accident. Neither had any medical conditions nor were they taking any prescription or non-prescription medications at the time of the accident.

*b.* Post accident toxicological tests

In accordance with Federal Regulations, following the accident train Q61822 engineer and conductor provided blood and urine specimens at a hospital in Monroe, N.C. Blood and urine specimens were also taken from the conductor and the engineer of train Q19423. The results for all the crewmembers were negative drugs and alcohol.[2]

## 3. Operational Factors

*a.* Training/Experience

[2] Blood and urine specimens were collected in less than 8 hours, which is consistent with FRA regulations.

Train Q61822

The engineer (36 years old) was hired on July 3, 2000 as a conductor. His promotional date as a locomotive engineer was March 28, 2004. His certification was revoked on March 5, 2005 to April 5, 2005 (he had made a reverse move at 33 mph – did not observe restricted speed). His next recertification date is 2012.

The conductor (49 years old) was hired and qualified as a conductor on September 4, 2005. He had been assigned to the extra board. On May 3, 2011, he received a score of 100% on his most recent T&E operating rules training.

CSX train Q19423

The engineer (35 years old) was hired on July 3, 2000 as a conductor and promoted to engineer on February 2, 2004. On March 1, 2011, he received a 98%.on his most recent T&E operating rules training. Since January 1, 2011, he had operated over the Monroe territory 44 times (which included 3 deadhead trips).

The conductor (33 years old) was hired and began training as a conductor on July 31, 2005. He had passed the 20, 40, and 55-day conductor trainee performance checklist. He became a qualified conductor in November 2005. He was then assigned to operate out of Greenville, S.C. where he had worked until the day of the accident. On March 1, 2011, he received a score of 86% on his most recent T&E operating rules training.

*b. Signal Compliance Testing*

The Human Performance Group identified two signals that are relevant to the accident trip. Below are rules, date of testing / location / and results of the signals tests for each crewmember:

Rule 1285: Approach
Rule 1291: Restricted Proceed

Train Q19423

Engineer:
Rule 1285: January 22, 2011 / Monroe sub / Complied
Rule 1291: No test shown

Conductor:
Rule 1285: April 20, 2011 / Abbeville, SC / Complied
Rule 1291: April 20, 2011 / Abbeville, SC / Complied

Train Q61822

Engineer:
Rule 1285: February 9, 2011/ Monroe Sub / Complied
Rule 1291: No test shown

Conductor: Rule 1285 and Rule 1291: No test shown

## 4. **Task Factors**

*a.* Accident trip sequence

The crew (engineer and conductor) of train Q61822 went on duty in Greenwood, South Carolina at 10:30 p.m. Their departure was delayed about an hour. During this time the crew of train Q19423 had arrived at the train yard and both crews talked to one another. The crew of train Q61822 told investigators that the engineer and conductor of crew Q19423 seemed fit for duty and did not mention any concerns about working that night.[3] Crew Q61822 then received a job briefing and boarded their train. They departed Greenwood about 11:30 p.m. and operated their train northbound. They knew that train Q19423 was scheduled to depart and operate behind them, though they did not know their exact location during the trip.[4]

The crew of train Q61822 told investigators that they did not think the accident territory (Monroe subdivision) was a difficult territory to operate. They had no problems seeing the signals that evening, and had not come across any dark signals. They also stated that during their trip, per CSX rules, they used their radio to call out the type of signals they observed, their train number, engine number, and the direction they were headed. They had also heard other trains communicating this information; however, at times their radio reception was poor. The conductor of Q61822 told investigators that crewmembers from other trains had communicated with them that the light on their EOT device was illuminated.

When they reached McDowell, train Q61822 entered a siding where they waited for another train to clear the tracks. After departing that area they proceeded to Catawba where they waited for another train to depart. After leaving Catawba they continued north to around Van Wyck when they started to follow train Q61623 while receiving a series of approach signals.

About 3:24:15 a.m. the crew of train Q61822 arrived at Mineral Springs and stopped their train at a red signal at MP SG 313.7. They also communicated their status over the radio. Train Q61623 was already stopped ahead of them for a red signal at SG 308.5.[5] After being stopped at the signal for about 10 minutes (during which time the signal had changed from red to yellow),

[3] The conductor of train Q61822 told investigators that the engineer of train Q19423 "was an excellent engineer" who knew his rules well and who he'd never seen do anything wrong. He was not aware of any personal or family problems. He said that the engineer and conductor of train Q19423 were friends.
[4] The engineer of train Q61822 told investigators that he recalled hearing the crew of Q19423 call out a signal one time early in the trip; they believed that train Q19423 was around Fuller and Clinton, South Carolina.
[5] As a point of reference, the 3 trains discussed in this report went by the north end of Waxhaw (SG 318.4) at the following times: Train Q61623: 3:03:50 a.m.; train Q61822: 3:15:10 a.m.; and train Q19423: 3:26:54 a.m.

the crew of train Q61822 heard the crew of train Q61623 call over the radio their [green] signal and their intentions to proceed north. Train Q61822 soon received a clear signal.

Post accident sight distance tests determined that about 3 minute before the accident (about 964 feet from the signal and near Collins Road) the crew of train Q19423 would have been able to observe signal SG 316.1. However, due to a burned out light bulb, this signal was not displaying any signal aspect when it should have been displaying a red aspect. Moments after passing Collins Road (MP 316.2) the engineer manipulated the throttle from throttle position 8.[6] The speed of the train – due, in part, to the topography - continued to increase from about 31 mph and reached a maximum speed of 48 mph. Event recorder data indicates that during the 78 seconds before the accident the engineer made throttle control manipulations, applied the dynamic brakes, and activated the bell and horn.[7] Event recorder data indicates that the crew made an emergency brake application about 1 or 2 seconds before the collision.[8]

At 3:34:53 a.m., before train Q61822 started to move (and before the conductor called the clear signal on the radio), they were struck in the rear of their train by train Q19423.[9] Both crewmembers of train Q61822 were knocked forward (the conductor was sitting in his chair and the engineer was getting ready to sit down) and received minor injuries. They then observed a fire at the rear of their train and then got off the locomotive. The engineer called the train dispatcher and the conductor called emergency 911. When the fire department arrived they talked to the crew of Q61822 and inquired about hazardous materials on their train. Later, both crewmembers and an emergency responder walked to the head end of train Q19423 and saw the conductor who was now outside the locomotive and lying on a stretcher. They talked for several minutes (they did not discuss details about the accident) before he was transported by helicopter and transported to a Carolina Medical Hospital in Charlotte, N.C. Both crewmembers of train Q19423 were fatally injured in this accident.

*b.* Cellular Phone Use

According to cellular phone records and NTSB analysis, neither crewmember of the train Q19423 had talked on his cellular phone during the accident trip. NTSB analyses also determined that the conductor had sent 8 text messages and received 8 text messages during this trip; the last outgoing text message was sent at 2:36 a.m., and the last incoming text message was received at 3:02 a.m.

[6] During the final minutes of the accident trip the engineer had manipulated the throttle from the T8 position to T6, T4, T2, idle, and off.

[7] Event recorder data also shows similar control maneuvers, in addition to dynamic braking, during the last 15 minutes of the trip.

[8] According to post-accident sight-distance testing (discussed later in this report), a crewmember positioned at the engineers side of cab would have been able to first detect train's Q61822 EOT device from a distance of 450 feet. Traveling at 48 mph, the crew of 194 would have had no more than 6 seconds to detect, identify and react to train Q61623.

[9] The crew of Q61822 stated that they had their air conditioner on and their engine was loud on the inside. Prior to the accident they never heard a train horn or any radio communications from train Q19423.

*c.* Sight-distance testing

On May 27, 2011, beginning about 4:50 a.m., investigators from the Human Performance and Operations Groups conducted sight-distance tests observe the last few miles of the Monroe subdivision up to the point of the collision. Investigators also determined the farthest possible distance where the last signal (SG 316.0) before to point of collision could be identified, and the distance where the rear end (i.e., end of train device) of train Q61822 could be detected. (A simulated obstruction device – similar to an EOT device – was used to represent the end of train Q61822). Two locomotives that were similar to those on train Q19423 were used in the testing. The weather at the time of the start of the tests was overcast and dark with temperatures in the 70's.

According to investigators in the operating cab during the sight-distance tests, the following signals or equipment could be observed clearly and accurately at the following distances from each side of locomotive cab:

| | |
|---|---|
| Signal SG 316.0 | 964 feet (engineer and conductor's side) |
| Simulated obstruction device<br>at the estimated point of impact: | 450 feet (engineer's side)<br>364 feet (conductor's side) |
| Observed reflection of light on the tracks<br>from the simulated obstruction device: | 419 feet (conductor's side)<br>450 feet (engineer's side) |

*d. Environmental Factors*

The engineer and conductor of train Q61822 told investigators that at the time of the accident the weather was clear with no fog in the area. They stated that they had had no problems seeing the signal aspects.

*e. Radio Tests*

On October 13, 2011, the NTSB, along with the parties to the investigation (CSX Transportation, Brotherhood of Locomotive Engineers and Trainmen, United Transportation Union) conducted radio tests near the accident site. The purpose of these tests was to simulate the radio announcement made by the crew of train Q61623 as it observed and announced the absolute signal at south Monroe, SG 306.2 to determine if the crew of train Q19423 could have received and understood the broadcast as they approached the final signal minutes before the collision.

Previously conducted interviews with the crew of train Q61623 determined the estimated time that the radio communication was made. These times were then matched with event recorder data from train Q19423 to determine the location of that train when the radio communication occurred. From this information, investigators determined that the crew of train Q19423 would likely have been traveling between MP 318.0 and 317.0 when the radio broadcast was made.

During the re-creation, radio announcements (similar to what was actually broadcasted by the crew of train Q61623) were made for each test by a UTU investigator on train Q61623. Each radio broadcast said: "Radio test. Radio test." Investigators from the NTSB and BLET stationed on train Q19423 evaluated each radio broadcast based on its quality: good, fair, poor, or no audio received.

The radio testing began at 4:45 a.m. and ended at 6:22 a.m. The weather at the time of the radio tests was misty, with fog present during the latter part of the tests as determined by the investigative team. The temperature was in the upper 50s .

The first radio test was conducted with train Q19423 stopped at MP 318.5. After that test was completed, train 184 was moved to MP 318.0. From MP 318.5 to MP 317.5, train Q19423 was moved and stopped every one-tenth mile. Identical radio announcements were made from train Q61623 while investigators on train Q19423 evaluated and recorded the reception quality of each radio broadcast. Additional radio tests occurred with train Q19423 positioned at the Collins Road crossing (MP 316.2), and lastly at the signal at MP 316.0. A total of 19 radio communication measurements were conducted.

The results of radio tests are found in the table below. The investigators agreed that each radio communication had some static, but in only one case (MP 316.7) did it interfere with the auditory recognition of the listeners.

| **TEST #** | **MILE POST** | **QUALITY OF RADIO RECEPTION** | | | |
|---|---|---|---|---|---|
| | | **Good** | **Fair** | **Poor** | **No Audio Detected** |
| 1 | 318.5 | | | | X |
| 2 | 318.0 | | | | X |
| 3 | 317.9 | | | | X |
| 4 | 317.8 | X | | | |
| 5 | 317.7 | X | | | |
| 6 | 317.6 | X | | | |
| 7 | 317.5 | X | | | |
| 8 | 317.4 | X | | | |
| 9 | 317.3 | X | | | |
| 10 | 317.2 | X | | | |
| 11 | 317.1 | X | | | |
| 12 | 317.0 | X | | | |
| 13 | 316.9 | X | | | |
| 14 | 316.8 | X | | | |
| 15 | 316.7 | | X | | |
| 16 | 316.6 | | | | X |
| 17 | 316.5 | X | | | |
| 18 | Collins Road MP 316.2 | | | | X |
| 19 | 316.0 (signal) | X | | | |

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