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: Red Oak, Iowa
MP 448.3 on #2 track, Creston subdivision on BNSF Nebraska Division
Carrier: BNSF
Trains: BNSF Coal Train 9159 and BNSF MOW equipment train 9470
Date: April 17, 2011
Time: About 6:55 a.m. CDT
Number: DCA-11-FR-002

B. HUMAN PERFORMANCE GROUP

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C. SUMMARY OF THE ACCIDENT

On April 17, 2011 at about 6:55 a.m. central daylight time, eastbound BNSF coal train C-BTMCNM0 26A, BNSF 9159 East, collided with the rear end of standing BNSF maintenance of way (MOW) equipment train U-BRGCRI5 15G, BNSF 9470 East, near Red Oak, Iowa. The accident occurred at milepost 448.3 on the number two track on the Creston subdivision of the BNSF Nebraska Division. The coal train was travelling about 23 mph when it struck the standing MOW train. The coal train consisted of 130 loaded coal cars, weighed 18,529 tons, and was 7,122 feet long with two locomotives on the head end and one locomotive on the rear end. The MOW train was consisted of 21 loaded cars, 13 empty cars, weighed 2,635 tons and was 3,170 feet long with one locomotive on the head end.

As a result of the collision, the two head-end coal train locomotives derailed along with the head two coal cars. The locomotive crew cab of the striking train was damaged and involved in a subsequent diesel fuel fire. Seven additional coal cars also were damaged but not derailed. Ten cars of the standing MOW train were derailed. Both the engineer and conductor on the coal train were fatally injured. The two crew members on the locomotive of the MOW train received minor injuries.[1] Damages are estimated at $8 million. The weather at the time of the accident was reported as 5 miles visibility with mist at Red Oak airport, which is about two and one-half miles east of the accident location.

Locomotive event recorder data indicate that just before the collision, train speed increased and the throttle was decreased as the train crested a hill west of the accident site. The coal train emergency brakes were not applied before impact.

[1] Both crewmembers reported back and neck pain. The conductor returned to work after being off a few days. On the date of this report the engineer has not returned to work.

Parties to this investigation are the Federal Railroad Administration, the BNSF railway, Electro Motive Diesel (the manufacturer of the leading locomotive on the coal train), the Brotherhood of Locomotive Engineers and Trainmen, and the United Transportation Union.

D. DETAILS OF THE INVESTIGATION

1. Behavioral Factors

Work/Rest

BNSF MOW equipment train

The engineer was called for duty by the BNSF on April 17, 2011, in Lincoln, NE at 12:05 a.m. and went on duty (the accident trip) at 1:15 a.m. The day before (Saturday April 16) he was called at 12:31 a.m., went on duty at 2:00 a.m. and traveled from Creston, IA, to Lincoln, NE. He went off duty at 1:45 p.m. and arrived at a nearby hotel around 2:30 p.m. He slept that afternoon for 3 ½ to 4 hours. That evening, he ate dinner and watched TV and remained awake until he was called for duty. The day before (Friday April 15) he had awakened between 6:30 a.m. and 7:00 a.m. and had the day off. He went to bed about 9:00 p.m. and slept between 3 ½ and 4 hours. The engineer was off duty April 11 – 15. He told investigators that he needs between 6 ½ and 7 hours sleep to feel rested.

The conductor was called for duty Sunday April 17, 2011, in Lincoln, NE at 12:05 a.m. and went on duty at 1:15 a.m. (He told investigators that he was "tired but not dozing-off-falling asleep tired"). The day before (Saturday April 16) he was called at 12:30 a.m., went on duty at 2:15 a.m. and traveled from Creston, IA, to Lincoln, NE. He went off duty at 1:45 p.m. at stayed at a local hotel. On Thursday April 14, he was called at 8:21 p.m. and went on duty at 9:50 p.m. He was on duty until 10:15 a.m. Friday April 15. The engineer told investigators that he needs about 5 to 6 hours sleep to feel rested.

BNSF Coal train[2]

The engineer was called for duty at 1:01 a.m. and went on duty on Sunday April 17, 2011 at 2:31 a.m. (the accident trip) in Lincoln, NE. He had been off duty for 12 hours and 1 minute, and had slept in an away-from-home lodging facility. The day before (Saturday April 16), he was called for duty at 3:02 a.m., went on duty at 4:30 a.m., traveled from Creston, Iowa, to Lincoln, NE, and went off duty at 2:30 p.m. He had not worked from April 11 to April 15.

The conductor was called for duty at 1:01 a.m. and went on duty on Sunday April 17, 2011 at 2:31 a.m. in Lincoln, NE. She had been off duty for 12 hours and 1 minute, and had slept in an away-from-home lodging facility. The day before (Saturday April 16) she

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

was called for duty at 3:00 a.m. went on duty at 4:30 a.m., traveled from Creston, Iowa, to Lincoln, NE, and went off duty at 2:30 p.m. On Friday April 15, she was on duty from 2:25 a.m. to 2:10 p.m. On Thursday April 14, she worked from 3:10 a.m. to 1:10 p.m.

2. **Medical Factors**

a. Health

MOW Train

The engineer indicated that his overall health was good. He had not been taking any prescription or non-prescription medications. He passed his most recent vision and hearing tests.

The conductor said that his overall health was good. He had not been taking any prescription or non-prescription medications. He had prescriptive glasses, which he was wearing while on duty. He passed his most recent hearing test.

Coal Train

The BNSF medical records for the engineer of the striking coal train indicated that his last hearing test was conducted on March 21, 2011. No exceptions were noted. His most recent vision examination also was on March 21, 2011. The records indicated that he did not wear glasses for distance or reading. His color vision was normal.

The NTSB obtained the engineer's medical records from his personal physician. His last visit to this clinic was on May 6, 2009. On that date, he weighed 228 lbs and his height was approximately 67 inches. His BMI[3] was 35.7 (which is categorized as obese). He had been diagnosed with Type 2 diabetes for several years and was prescribed prandin, glucovance, and actos. He also was prescribed diovan for high blood pressure, as well as vytorin and crestor for high cholesterol.

The BNSF medical records for the conductor indicated that she had sustained an injury on November 4, 2010 (and was subsequently out of service for several months). These records indicated that she had "impingement problem shoulder" and that she required surgery. These records indicated she could return to work - full duty with no restrictions - effective March 18, 2011. The November 4, 2010 records also indicated that she was taking diavan (for high blood pressure) and mirapex (prescribed to treat her restless leg syndrome). She returned to work on March 21, 2011, and had been released to full unrestricted duty. Her hearing tests conducted on May 5, 2010 indicated that her hearing was normal. She passed her vision test on April 3, 2009.

[3] Body mass index (BMI) is a key index for relating a person's body weight to their height. BMI is a person's weight in kilograms (kg) divided by their height in meters (m) squared. Obesity is defined as a BMI of 30 and above, according to the NIH.

The NTSB obtained the conductor's medical records from her personal physician. The Board also noted various medications from her locker that were recovered post accident. The following information is based on information from these two sources:

The conductor's medical records indicated that she was 64 ¼ inches tall and weighed 221 lbs on November 8, 2010. Her BMI was 37.6 (which is in the severely obese range). She was being treated for high blood pressure with a both metoprolol and valsartan, but was noted to be hypertensive on November 8, 2010 with a blood pressure of 140/88. In addition, she was being treated for restless leg syndrome with ropinirole. Medications found in her locker included temazepam (used to treat insomnia), which was prescribed on March 9, 2011. She also had diphenhydramine, an over-the-counter sedating antihistamine, in her locker. She had been taking venlafaxine (an antidepressant). There was no indication of a sleep study in the records provided.

b. Post accident toxicological tests

In accordance with federal regulations, following the accident the MOW train engineer and conductor provided blood and urine specimens at a hospital in Creston, Iowa. Blood and urine specimens also were collected from the engineer and conductor of the coal train. The results were negative for illicit drugs and alcohol for all of the crewmembers.

Additional toxicological analyses on specimens from the coal train conductor and engineer were conducted at CAMI (Civil Aeronautical Medical Institute) in Oklahoma City, OK. The coal train conductor's toxicological results showed that valsartan (a prescription medication used to treat high blood pressure) was detected in the urine and blood. Results for the coal train engineer showed that chlorpheniramine (used to treat symptoms related to allergies and the common cold) was found in the urine but not in the blood. In addition, ranitidine (used to treat ulcers and GERD) was found in both his blood and urine.

c. Autopsy reports

The NTSB requested and received autopsy reports for the coal train engineer and conductor. The engineer's autopsy toxicological analysis of the heart blood revealed ranitidine (Zantac) 100 ng/mL, and caffeine. The report concluded that the cause of death was "blunt force injuries of head and thermal injuries."

The conductor's autopsy toxicological analysis of the heart blood revealed no detectable concentrations of drugs on a comprehensive drug panel. The only positive result was for stimulants (caffeine). The report concluded that the cause of death was "blunt force injuries of head." The report also stated, "Other significant: thermal injuries."

3 **Operational Factors**

a. Training/Experience

MOW train

The engineer (43 years old) began working in the railroad industry in 1994 as a conductor trainee. His engineer seniority date was April 16, 1995, and he had worked in this capacity since then.

The conductor (26 years old) began working in the railroad industry in Los Angeles, CA. He was hired by BNSF on February 2, 2004. His seniority date as a locomotive engineer (Los Angeles Division Roster) was August 6, 2006.

Coal train

The engineer (48 years old) was hired by the BNSF on July 14, 1997 as a conductor/brakeman/switchman. His seniority date as an engineer was February 28, 1999. His engineer recertification was on April 13, 2011.

Disciplinary actions. The following incidents are included in the engineer's record:

May 30, 2006: Improper train handling

November 14, 2008: Improper train handling

March 11, 2009: Other serious operating rule (moving violation)

November 24, 2009: "Failure to control speed exceeded authorized speed by entering turnout at 35 mph at MP 447.5 at a speed of 35 mph GCOR 6.31." This violation resulted in a 30-day suspension.

January 27, 2011: 'Lay off on call' at 2122 hours on 1/27/2011 when called to protect train E RTREMBO 05A on duty at 2250 hours 1/27/11 GCOR 1.16, 1.13 & 1.15." This violation resulted in a 10-day suspension.

The engineer had been placed on an Employee Review Process (ERP) on March 11, 2009.[4] He was in the ERP program at the time of the accident.

[4] According to BNSF, the Employee Review Process (ERP) is to help employees work the remainder of the career without an accident or injury. When an employee's record indicates that individual assistance is needed, the supervisor will contact the affected employee and conduct and ERP session. Multiple criteria for selection of employees may be used, including: injury history; human factor rail equipment incidents; operations testing failures; newer employees with incidents or injuries; other supervisor knowledge of employee performance concern. Employees in this program are tested more frequently on train operations, have their event recorders taped reviewed, and meet with their supervisors on a regular basis.

The conductor (48 years old) was hired by the BNSF on November 22, 2004 as conductor/brakeman/switchman. Her seniority date as an engineer was January 21, 2007.

Disciplinary actions. The following incident is included in the conductor's record:

June 23, 2009: "Excess speed in restricted speed." (She was operating as a conductor at the time of this violation.)

4. Task Factors

a. Accident trip sequence.

The crew of BN 9470 (MOW train) went on duty at 1:15 a.m. in Lincoln, NE, and departed about 3:15 a.m. A couple of hours into their tour, the crew came upon two coal trains directly ahead of them on No. 2 main track. The first coal train was stopped at CP McPherson (MP 447.5). Consequently, BN 9470 stopped for a red signal at CP 453.5.

After the first coal train departed Control Point (CP) McPherson, the second coal train proceeded to CP McPherson where it stopped. BNSF 9470 then received a yellow signal at CP 453.5 and began to operate at restricted speed. Then, they operated toward the red grade signal and continued at restricted speed until they stopped 300-feet behind the 2nd coal train. While stopped, eastbound Amtrak train #6 (California Zepher) passed them on track No. 1 about 6:22 a.m. As the coal train directly ahead of them began to move, train BN 9470 proceeded to CP McPherson and stopped at the red signal.[5] After several minutes, the crew attempted to call the train dispatcher to inquire about train traffic. However, perhaps due to the dispatcher change-over, the dispatcher did not answer. Moments later, the crew felt their train being hit from behind and was shoved forward. After the impact, the engineer exited his train and ran to the rear of the train where he observed smoke and fire. He then called 911.

Until the time of the accident, the BN 9470 trip was uneventful and the crew's overall workload was typical for that territory. They had no problems accurately identifying the signal aspects.

The crew of BNSF 9159 (coal train) went on duty at 2:31 a.m. in Lincoln, NE. About 6:08 a.m., the Amtrak train, California Zepher, traveling at 79 mph, passed them at MP 467.9. The Amtrak engineer told investigators that he observed a crewmember on BNSF 9159 in the conductor's seat in a reclining position. BNSF 9159 continued eastbound on track #2 and passed a signal at CP 453.5 (displaying a yellow aspect) traveling at 30 mph in the throttle 1 position.[6] Later they passed a signal at MP 450.38 (displaying a red aspect) traveling 12 mph in throttle position 7. The train continued to travel between 11

[5] At this signal, the red aspect was not a stop signal but a restricted proceed (G grade marker board) and the crew was within the rules of their speed (12 mph) being governed by that signal indication.
[6] The train's speed and throttle positions were collected from event recorder data taken from BNSF train 9159.

and 12 mph to MP 449.4, where it began to accelerate to 23 mph when the collision occurred (with the throttle in position 4).

Below is a table developed from the event recorder data from the BNSF 9159 coal train that shows when the engineer used the controls of the locomotive between CP 4535 and the point of collision, as well as the distance traveled between each activity.

Time	Activity	Speed MPH	Distance Traveled In Feet Since Last Activity
6:36:11 – 63614	Throttle 3 to 2 to 1	34	(Start near CP 4535)
6:38:25	Throttle 1 to 2	27	5,801
6:38:33	Throttle 2 to 3	27	245
6:40:22 – 6:40:42	Long, Long, Short, Long - Horn Pattern		3,928
6:40:48	Alerter Reset by Manual Button	22	192
6:40:54	Throttle 3 to 4	21	186
No activity for 2 minutes 2 seconds			
6:42:56 – 6:43:02	Alerter Alarm Begins 7 Second Duration 5 Seconds Flashing Light 2 Seconds Light And Horn Alerter Reset by Manual Button	16	3,400
6:43:05	Throttle 4 to 5	16	69
6:44:02 -6:44:05	Throttle 5 to 4 to 5	14	1,283
6:44:22	Throttle 5 to 6	13	338
6:46:10	Throttle 6 to 7	12	1,999
6:47:07	No Activity Passing Grade Signal	13	
No activity for 2 minutes 1 seconds			
6:48.11 – 6:48:18	Alerter Alarm Begins 8 Second Duration 5 Seconds Flashing Light 3 Seconds Light And Horn Alerter Reset by Manual Button	13	2,224
6:48:55	Throttle 7 to 6	13	689
6:49:42	Throttle 6 to 5	12	845
6:50:48	Throttle 5 to 6	10	1,053
6:51:00	Manual Sand Ends	11	186
No activity for 2 minutes 2 seconds			
6:53:02 – 6:53:09	Alerter Alarm Begins 8 Second Duration 5 Seconds Flashing Light 3 Seconds Light And Horn Alerter Reset by Manual Button	17	2,452
6:53:11	Throttle 6 to 5	18	52
6:53:12	Throttle 5 to 4	18	27
No activity for 1 minute 53 seconds			
6:55:05	Collision	23	3,344

b. In cab image and audio recorders

None of the locomotives involved in the collision were equipped with an inward-facing camera or with an audio recording device. The lead locomotive of the coal train was equipped with a forward-facing camera that was destroyed in the collision; as a result, data recovery was not possible. The trailing locomotive BNSF 6133 on the coal train also was equipped with a forward-facing camera. There are no federal regulations that require locomotives or train operating compartments to be equipped with these types of cameras or audio recorders.

c. Locomotive Alerter[7]

The locomotive of BNSF 9470 was equipped with a locomotive alerter.

d. Cellular Phone Use

The NTSB investigation obtained cellular phone records for the engineer and conductor of BNSF 9159. These records indicated that neither the engineer nor the conductor used their cell phone for verbal communication or for texting during the accident trip.

While off-duty on April 16, 2011, the engineer made several outgoing calls, the majority of them between 3:51 p.m. and 4:17 p.m. The last call he made that day using his cell phone was at 6:46 p.m.

The conductor had not used her cell phone on the day of the accident, and rarely used it on the day before the accident.

e. Sight-distance testing

On April 20, 2011, the NTSB, along with the parties to the investigation, conducted sight-distance tests to determine the farthest possible distance where the two signals leading up to the accident site could be identified, and where the HGZX-150 MOW clip car[8] at the rear end of train could be detected. These observations were conducted within an hour of the time of day that the accident had occurred. The weather during the tests was similar to that described by the crew of the MOW equipment train at the time of the

[7] An alerter is a device or system installed in the locomotive cab to promote continuous, active locomotive engineer attentiveness by monitoring select locomotive engineer-induced control activities. If fluctuation of a monitored locomotive engineer-induced control activity is not detected within a predetermined time, a sequence of audible and visual alarms is activated so as to progressively prompt a response by the locomotive engineer. Failure by the locomotive engineer to institute a change of state in a monitored control, or acknowledge the alerter alarm activity through a manual reset provision, results in a penalty brake application that brings the locomotive or train to a stop. Source: 49 CFR 238.5 [Title 49 – Transportation; Subtitle B.

[8] HGZX-150 is maintenance of way equipment that installs clips on the rail. The clips secure the rails to the railroad ties. This type of vehicle is commonly referred to as a 'clip car'. The car was constructed from mild steel, weighed 177,000 lbs., painted yellow and was 54 ft. in length.

accident. Along the perimeter of the tracks, there were tall trees (many without leaves), large bushes with leaves, and other foliage.

According to investigators in the operating cab during the sight-distance tests, the following signals or equipment could be detected visually at the following distances:

2 E Signal at MP 453.5 (CP 4535) ("Approach" signal displaying yellow): **4,658 feet**
2 EA Signal at MP 450.3 ("Restricting" signal displaying red): **3,147 feet**
The clip car (positioned at the point of impact): **1,364 feet**

Clip car with an end of train (EOT) device (red) and reflectors.

f. Environmental Factors

The engineer of the MOW train told investigators that at the time of the accident the weather was cloudy, with no fog in the area. He stated that visibility was very good (which he estimated to be between 3 and 5 miles). He stated that he had had no problems identifying the signal aspects.

Compiled by: /s/ Date: December 5, 2011
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