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 FACTUAL REPORT

A. ACCIDENT

Location: Near Liberal, Missouri (Barton County, Mo)
Carrier: Kansas City Southern Railroad and BNSF Railroad
Trains: KCS Train QSHKC20
BNSF Train EMHSEBM088
Date: July 21, 2012
Time: About 3:30 p.m. central daylight time
Number: DCA-12-FR-007

B. HUMAN PERFORMANCE GROUP

Group Chairman

Stephen M. Jenner
Human Performance Investigator
National Transportation Safety Board
490 L'Enfant Plaza East, S.W.
Washington, D.C. 20594
(202) 314-6416
Jenners@ntsb.gov

Group Members

Chad Devenney
Kansas City Southern Railroad

Rance Randle
BNSF Railway

Mike Corum
Federal Railroad Administration

Kimble Jackson
Brotherhood of Locomotive Engineers and Trainmen

Nile Dragoo
United Transportation Union

C. SUMMARY OF THE ACCIDENT

On July 21, 2012 at about 3:30 p.m. central daylight time, Kansas City Southern Railroad freight train No. QSHKC20, consisting of five locomotives and 81 cars of mixed freight, collided with the side of BNSF Railway freight train No. EMHSEBM088, consisting of two locomotives (one was a distributed power locomotive[1]) and 124 freight cars (all empty coal cars) at a diamond crossing near Liberal (Barton County), Missouri.

The BNSF train was operating westbound on the BNSF main track under a centralized traffic control (CTC) signal system. The crew had previously received a diverging approach signal from the BNSF train dispatcher (located in Ft. Worth, TX) to proceed west through the crossing and into the BNSF Arcadia siding. The BNSF train was traveling about 35 miles per hour at the time of the collision.

The KCS train was operating northbound on the KCS main track under a CTC signal system on the Pittsburg Subdivision. They had just recently changed train crews at Pittsburg, KS, about 15 miles south of the location of the collision. The KCS train approached the crossing at a recorded speed of 24 miles per hour.

The collision occurred at milepost 114.6 of the Pittsburg Subdivision. The diamond is known as the BNSF / KCS crossing.

Two KCS crewmembers were injured as a result of the accident. Both crewmembers had jumped from the lead locomotive prior to the collision. One was treated and released from the hospital. The second was kept in the hospital under observation and was released the following day. The two BNSF crewmembers were not injured in the accident.

The derailed equipment included five locomotives and five cars on the head end of the KCS train. Fifteen cars of the BNSF train were derailed. Total damages are estimated to be $6.2 million.

Weather at the time of the accident was clear. The temperature was 92 degrees.

[1] A distributed power system is a system that provides control of a number of locomotive dispersed throughout a train from a controlling locomotive located in the lead position.

Figure 1. *Aerial picture shows a northbound Kansas City Southern Railroad mixed freight train (pictured traveling from right to left) that had collided into the side of a westbound BNSF Railway empty unit coal train (pictured traveling from top to bottom) at a joint KCS / BNSF diamond crossing near Liberal (Barton County), Missouri.*

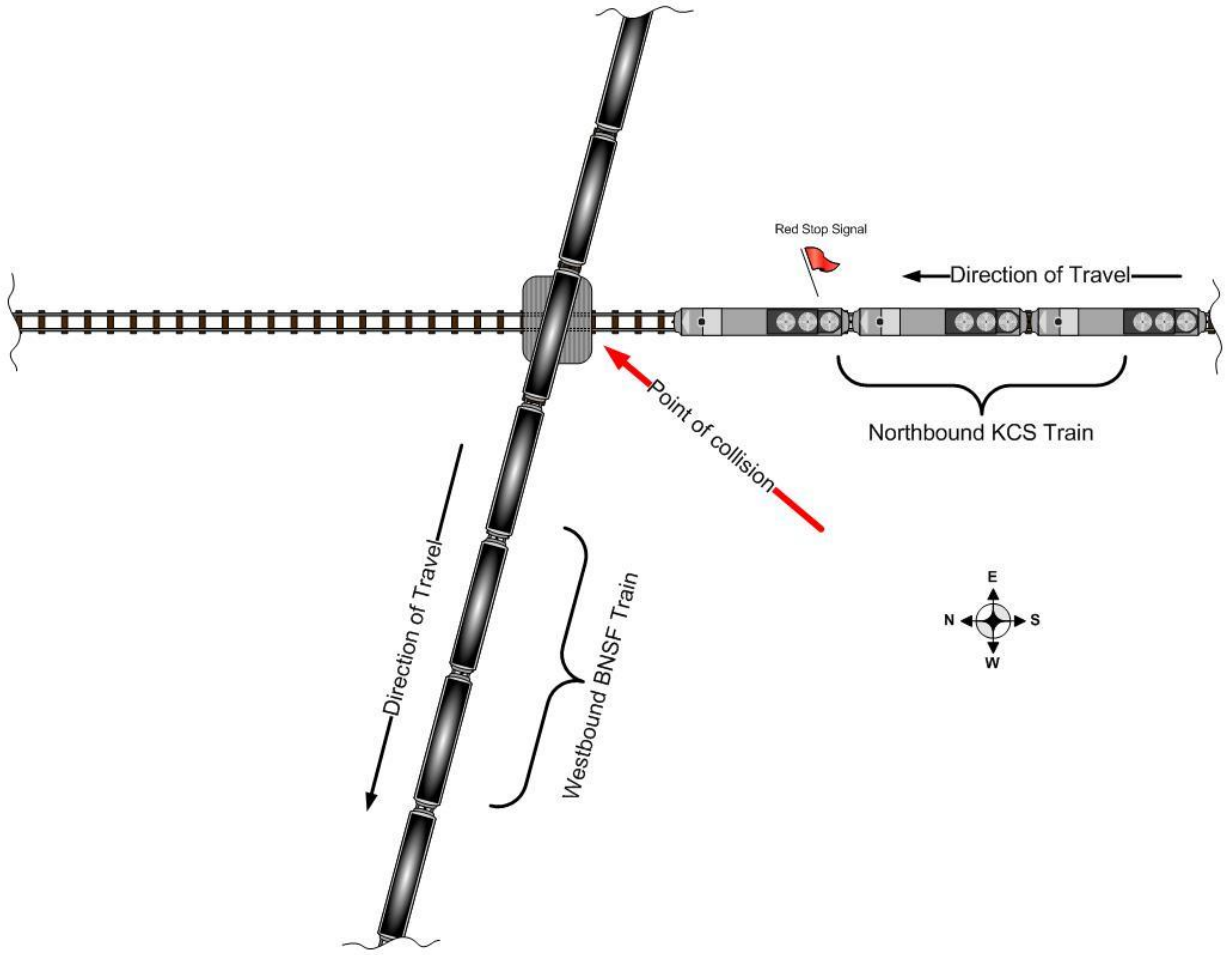

Figure 2. *This diagram shows a schematic layout of the location where the accident occurred. This diagram has the same orientation as the aerial picture seen in figure 1. Three KCS locomotives are shown traveling north (right to left). The KCS train is pictured just a few feet short of striking the BNSF freight train. Seven cars from the northbound BNSF freight train (traveling from top to bottom on this diagram) are shown covering the entire length of the section of track, which includes the interlocking (the point of collision). The red flag on the KCS track indicates the location of the red signal the KCS crew passed seconds before striking the side of the BNSF train.*

D. DETAILS OF THE INVESTIGATION

1. Behavioral Factors

a. Sleep/wake/work history

Based on personnel records and interviews with investigators, the sleep/wake/work histories of the crewmembers involved in the accident were gathered. The information for the engineer and conductor of train KCS train are included in the tables (below).

DATE	TIME	ACTIVITIES OF THE KCS ENGINEER
7/13/2012	1:30 a.m.-7:25 a.m.	On duty / Operate train
7/14	3:00 a.m. – 10:30 a.m.	On duty / Operate train
7/18	3:20 p.m. – 11:40 p.m.	On duty / Operate train
7/19-7/20	10:00 p.m. – 7:52 a.m.	On duty / Operate train to Pittsburg
7/20	8:00 a.m.	Arrive home
7/20	9:00 a.m-12:00 p.m.	3-hour nap
	12:00 p.m. -11:00 p.m.	Spent the day at home
7/20	11:00 p.m.	Went to bed and fell asleep quickly
7/21	9:00 a.m.	Awoke
	9:00 a.m. – 12:10 p.m.	Remained at home
7/21	12:10 p.m.	Received call from KCS to report for duty in 90 minutes
	1:30 (approx.)	Departed house for train yard in Pittsburg
7/21	1:40 p.m. – 3:30 p.m.	On duty in Pittsburg - accident

Additional information: The engineer's drive time from his residence to his home terminal was about five minutes. His normal call time before going on duty was 90 minutes. He normally slept between six and seven hours (the amount he needed to feel rested). He indicated that if he did not work (e.g., if he were on vacation) he would sleep from about 10:00 p.m. to 4:00 a.m. or 5:00 a.m. He did not normally take naps unless he was very tired. He told investigators that prior to the accident he his quality of rest was "excellent" and he felt "very alert."

DATE	TIME	ACTIVITIES OF THE KCS CONDUCTOR
7/12	9:30 a.m. – 7:50 p.m.	On duty
7/13	9:30 a.m. – 6:30 p.m.	On duty
7/15	8:30 a.m. – 2:11 p.m.	On duty
7/16	11:00 a.m. – 9:15 p.m.	On duty
7/18	12:01 p.m. – 10:30 p.m.	On duty
7/18–7/19	11:00 p.m. – 6:25 a.m.	Sleep
7/19-7/20	4:00 p.m. – 3:10 a.m.	On duty
7/20	4:00 a.m. – 9:00	Sleep

	a.m.	
7/20	Day	Off duty
7/20	11:00 p.m. – 6:30 a.m.	Sleep
7/21	1:40 p.m. – 3:30 p.m.	On duty in Pittsburg - accident

Additional information: The conductor's drive time from his residence to his home terminal was about 40 minutes. His normal call time before going on duty was 90 minutes. He normally went to bed at 11:00 p.m. He typically slept between 6 and 7 hours. He told investigators that prior to the accident his quality of rest was "excellent" and he felt "very alert."

BNSF train crew

The BNSF engineer was not able to provide investigators a detailed work/rest routine of his activities 72 before the accident. He told investigators that he normally went to bed about 10:30 p.m., and slept between 7-8 hours. He occasionally took naps that lasted 1-1 ½ hours, although he did not nap prior to going on duty. He indicated that his quality of rest prior to the accident was excellent and he felt "very alert." On the day of the accident he had been notified of his assignment about 9:55 a.m. His commute time from his residence to the train yard was about 20 minutes. On the day of the accident he went on duty at 11:25 a.m.

The BNSF conductor also was not able to provide details of his work/rest routine 72 hours before the accident. On the day of the accident he went on duty at 11:25 a.m.

2. MEDICAL FACTORS

a. Health

KCS train crew

The KCS engineer passed his last physical in July 2010. He wore prescriptive glasses for reading. He indicated that his overall health was good. Occasionally he took oxycodone[2] for back pain. He took Prilosec[3] daily for heartburn. He had not been diagnosed with any sleep disorders. As a result of him jumping from the train moments before the accident, he was sent to the hospital for treatment. He suffered broken ribs, a broken collar bone, and a gash on his head that required staples. He was treated and released from the hospital that same day.

[2] Oxycodone is an opioid narcotic pain reliever similar to morphine. An opioid is sometimes called a narcotic. It is used to treat moderate to severe pain.

[3] Prilosec (omeprazole) belongs to a group of drugs called proton pump inhibitors. Omeprazole decreases the amount of acid produced in the stomach. It is used to treat symptoms of gastroesophageal reflux disease (GERD) and other conditions caused by excess stomach acid. It is also used to promote healing of erosive esophagitis (damage to your esophagus caused by stomach acid).

The KCS conductor passed his last physical in April 2012. He had no operating restrictions based on his vision or hearing. He wore corrective glasses for reading, and had some hearing loss. He had no chronic medical conditions, and had not been taking any prescription or non-prescription medications prior to the accident. He regularly took multivitamins. He snored on occasion, but had never been diagnosed with any sleep disorders.

BNSF train crew

The BNSF engineer told investigators that his overall health was good, although he had some chronic pain due to an automobile accident years earlier. He passed his last physical in 2009. He has not been diagnosed with any sleep disorders. Prior to the accident he indicated that he felt very alert.

The BNSF conductor told investigators that we was in "pretty good" health, although he had some chronic pains from a non-work accident years earlier. He took a prescription medication (for digestion purposes) as a result of that prior accident, as well as Imodium (non-prescription) 2-4 times per day. He wore corrective lenses for distance vision. He had not been diagnosed for a sleep disorder, and indicated that he slept well. He told investigators that he felt very alert prior to the accident.

b. Post accident toxicological tests

In accordance with federal regulations, following the accident all four crewmembers from both trains involved in the accident provided blood and urine specimens for post accident toxicological testing. The KCS engineer provided a blood specimen at 10:49 p.m., and a urine specimen at 11:19 p.m.at a hospital in Joplin, Missouri. The KCS conductor provided a blood specimen at 8:09 p.m. and a urine specimen at 8:30 p.m. at a facility in Pittsburg, KS. The results were negative for illicit drugs and alcohol for all four crewmembers involved in the accident.

3. Operational Factors

a. Hired dates/Disciplinary Actions

The KCS engineer was hired on April 17, 1995 and worked as a conductor for two years. He later became a certified engineer and has been working in that capacity for about 14 years. He had operated over the accident territory for about 16 years. He worked a regular assignment.

The KCS conductor was hired on August 28, 1995. Prior to that he had worked in the railroad industry for 19 years in various capacities. He was involved in a previous accident/incident in January 2012. While working as a conductor, his train proceeded past a stop signal in a Kansas City train yard. He was disciplined by the railroad and returned to service in April 2012.

The BNSF engineer's seniority date is June 2, 1998, and he has been a certified engineer for 9 years. He had been off work for over a year while recovering from a non work-related injury.

The BNSF conductor's seniority date is March 22, 1973. He has been operating as a conductor for 39 years.

4. Task Factors

a. Accident trip sequence

BNSF Train

The BNSF train crew was called at Springfield, Missouri at 11:25 a.m. The crew consisted of a locomotive engineer and a conductor. They were instructed to operate their train from Springfield to Fort Scott, Kansas, where it would be handed over to another BNSF train crew.

The BNSF train departed Springfield at about 12:45 p.m. Their trip had been uneventful and the workload was normal. Minutes before the accident the engineer was operating the train just under the 45 mph speed restriction for that area. The crew observed the approach signal to the south end of Arcadia[4] displaying double yellow (approach diverging). This indicated that the crew would be taking the siding at Arcadia. The crew continued to operate their train around a curve and then more tangent track where they observed the signal at the interlocking (diverging approach).

The engineer slowed the train to the mid thirties and the train began to enter the siding near the location of the interlocking signal. The train was about two car lengths into the siding when the crew felt a "jerking" motion. Soon after the train went into emergency. The engineer then activated the toggle switch to activate the two-way end of train (EOT) device. Moments later the train had stopped. The conductor called out "Emergency" and identified his location using his radio. The engineer hit 911 on the radio and received a very quick response from the train dispatcher. The crew then identified the other train involved in the accident as a KCS freight train. Both BNSF crewmembers left their train to find and provide assistance to the KCS crewmembers.

[4] Arcadia is the name of the BNSF siding located just west of the crossing.

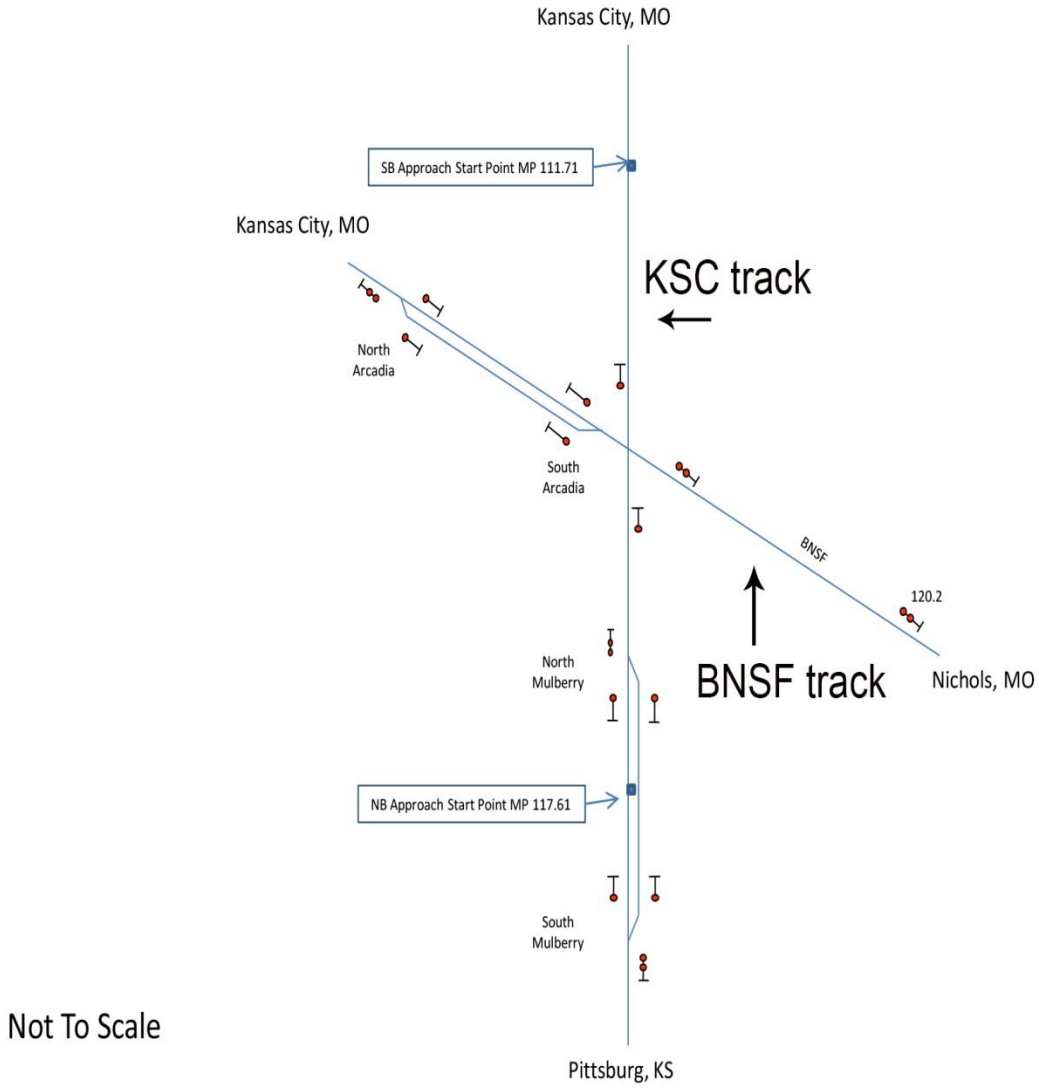

Figure 3. *This diagram identifies several signals on both the KCS and BNSF tracks leading up to the interlocking. (The diagram was developed by investigators from the Signal Group).*

KCS Train

The crew (locomotive engineer and conductor) of the KCS train went on duty at 1:40 p.m. at a train yard in Pittsburg, Kansas. They had to wait about 80 minutes for the train they would be operating to arrive at the train yard.

The KCS crew departed the yard about 3:20 p.m. and headed north.[5] Shortly thereafter, the train KCS train dispatcher communicated to the crew via radio that they would probably meet a train in Hume (about 55 miles from Pittsburg). The maximum authorized speed for their train was 55 mph.

Early in the trip the conductor first realized that the operating compartment radio did not have a microphone. (The conductor told investigators that without a microphone one cannot call out signals over the radio). The crew later operated past a defect detector at milepost 124.9, and no problems were reported with the train.

The KCS train arrived at South Mulberry and received a medium approach signal (displaying a flashing yellow aspect). The engineer then reduced the train's speed in order to operate at the 35 mph speed restriction. The crew continued to operate their train to North Mulberry. Both crewmembers told investigators that they each observed a clear (green) signal indication at North Mulberry. (Postaccident testing indicated that the signal at North Mulberry was an Approach signal displaying a solid yellow aspect).

After passing the signal at North Mulberry the train traveled around a curve. According to the crew, at a distance of approximately 25 car-lengths, they observed a red signal at the Home signal at the interlocking.[6] Immediately afterwards the crew saw the BNSF train entering and crossing over the interlocking.[7] The crew told investigators that the engineer immediately applied emergency braking. The engineer did not activate the two-way end-of-train device. (He told investigators, "It did not cross my mind.")

The crew then made the decision to evacuate the operating compartment and jump off the train. The engineer went out the back door, followed by the conductor. Each crewmember went to the back of the locomotive and down the steps and jumped from the bottom step. Both jumped off the train about 70 to 80 feet before the collision. Both crewmembers were injured after they jumped. The engineer was sent to the hospital for treatment. He suffered broken ribs, a broken collar bone, and a gash on his head that required staples. The conductor also hit his head and sustained other minor injuries. He was transported by ambulance to a hospital in Pittsburg where he was treated and released the same day.

[5]There were five signals between the train yard in Pittsburg and the Interlocking where the accident occurred. The first signal leaving Pittsburg is on the right side, and all the others are on the left.

[6] The operation of the interlocking is achieved by the BNSF dispatcher requesting a desired route through the interlocking. The route is stored and only executed once a BNSF train steps onto the approach circuit. The approach circuits extend out from the crossing to the intermediate signal located at MP 120.2 on the east side and North Arcadia Controlled Point MP 116.9 on the west side.

[7] The BNSF and KCS track arrangement at the location of the derailment consists of a diamond crossing of 58 degrees.

Figure 4. *This photograph was taken by the KCS freight train's outward facing camera positioned on the lead locomotive. The Home signal can be seen ahead of the train on the right side of the tracks. The KCS train is likely less than 10 seconds before impact with the BNSF train, which is now traversing the interlocking. It is estimated that this was the point where the KCS crew jumped from the lead locomotive.*

b. Sight-distance test

On July 25, 2012, about the time of the accident, investigators conducted sight-distance tests to determine the farthest possible distance where an operating crew could identify the aspects of the last three signals before the accident site. The weather at the time of the testing was clear with party cloudy skies (the clouds did not block out the sun). The results of the sight-distance test are included in the table (below).

Signal	**Indication or Aspect**	**Distance Aspect was Identified**	**Time of Day Observed**
South Mulberry	Medium Approach (Flashing Yellow)	Engineer: 1365 feet Conductor: 1335 feet	4:40 p.m.
North Mulberry	Approach (Yellow)	Engineer: 9010 feet Conductor: 9010 feet	4:49 p.m.
Home (@ Interlocking)	Red	Engineer's side: 3140 feet Conductor's side: 1939 feet	5:05 p.m.

The distance from the Home Signal to the Interlocking is 177 feet.

c. Workload

The engineers and the conductors of both the KCS and the BNSF freight trains told investigators that their overall workload during the accident trip was normal and routine. None of the crewmembers reported seeing environmental factor (e.g., fog, haze, or rain) adversely affected their vision of the signals. The crew told investigators that the sun was "beating on" the Home signal at the interlocking. Neither crewmember indicated that the sun was a factor on their visibility of the signal at North Mulberry.

d. Cellular Phone Use

Cell phone records of the crewmembers involved in the accident were acquired and reviewed. The records show no calls or text messages were sent or received by crewmembers of either train during the time when each train was being operated.

e. Weather

Weather at the time of the accident was mostly sunny, dry and clear. Temperature at the time of the accident was 92-degrees.