National Transportation Safety Board

Factual Report
(post tech review with party comments incorporated)

Synopsis

On May 25, 2013 at 2:30 a.m., central daylight time[1], near Chaffee, Missouri, Union Pacific (UP) southbound freight train, 2-ASMAR-25 collided with BNSF southbound[2] freight train U-KCKHKM0-05T, at Rockview interlocking. The BNSF train was occupying the interlocking when the UP train struck the 12th car behind the locomotives of the BNSF train. As a result of the collision, 13 cars of the BNSF train were derailed. Two locomotives and 11 cars on the UP train were derailed. Spilled diesel fuel from the derailed UP locomotives caught fire. The Missouri State Highway M Bridge was above the Rockview interlocking and collision forces resulted in the collapse of portions of the highway bridge. The engineer and conductor on the UP train were the only crew members that were injured and they were transported to a local hospital. Subsequent to the bridge collapse, two motor vehicles struck damaged highway elements. Five occupants of the motor vehicles were transported to a local hospital. It was clear and 48° F at the time of the accident. Damage was estimated to be in excess of $11 Million.

Train Information

Train ID --	Lead Unit	Collision Sequence
2-ASMAR-25	UP 5668	Striking Train
U-KCKHKMO-05T	BNSF 4138	Struck Train

Table 1: Train IDs

[1] Unless otherwise noted, all times are CDT
[2] Railroads use timetable directions to describe train movements. Timetable directions do not always correspond with compass directions.

Train	Locomotives	Loads	Empties	Weight	Length[3]
2-ASMAR-25	UP 5668 UP 7421	60	0	4,782 Tons	5,490 Feet
U-KCKHKMO-05T	BNSF 4138 BNSF 5295 BNSF 7750	75	0	8,848 Tons	4,264 Feet

Table 2: Train Consist Information

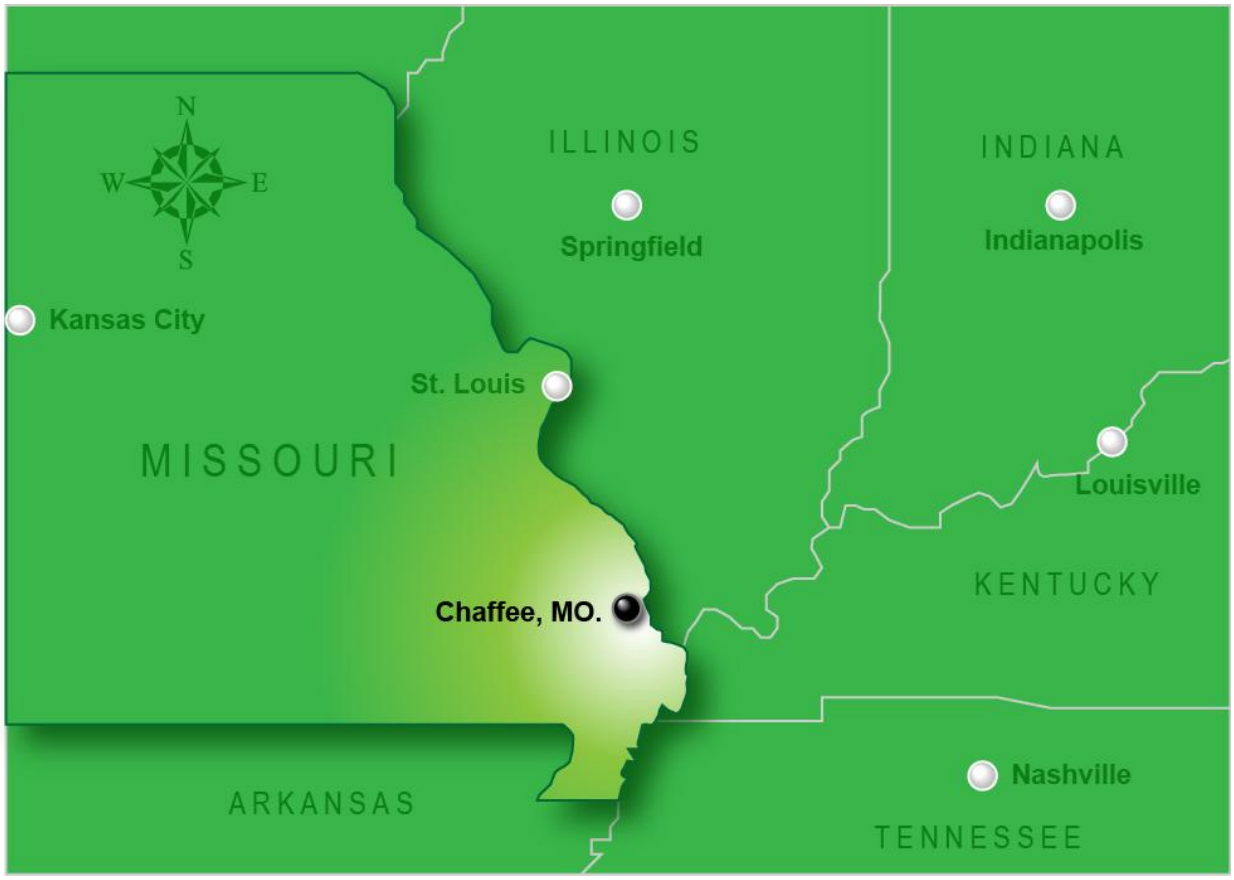

Figure 1: Map Showing Chaffee, Missouri

Operational Plan

Both trains were operating southbound on their respective railroads. The collision occurred at Rockview Interlocking, a location where the UP and BNSF railroads cross each other near Chaffee, MO. The interlocking operates on a first come, first served basis. The BNSF train arrived first and received a clear (green aspect) signal to enter the interlocking and cross the UP

[3] Length includes locomotives

tracks. The interlocking equipment displayed a stop signal to the UP train. Had the accident not occurred, the interlocking signals were designed such that the UP train would have received a signal to proceed after the BNSF train cleared the interlocking.

Accident Narrative

Struck Train – BNSF 4138 South

The crew (engineer and conductor) of the BNSF train took charge of their train in Lindenwood Yard (St. Louis, MO), at 7:00 p.m. and departed at approximately 8:32 p.m. The BNSF train had three locomotives on the head end and 75 cars. According to the crew their trip was routine until the collision.

At Rockview (BNSF MP 141.7), the BNSF crew stated they entered the interlocking on a clear (green aspect) signal. They said that they saw the UP train's headlight and that it was not unusual to see a train on the UP at this location. After the locomotives and 12 cars passed the diamond crossing with the UP, the BNSF train was struck by the southbound UP train causing an emergency brake application.

Striking Train – UP 5668 South

The crew (engineer and conductor) of the UP train went on duty at Salem, Illinois at 9:45 p.m. and departed at 10:10 p.m. They had 2 locomotives on the head end and 60 cars.

According to the crew, they met one opposing train at Mt. Vernon, Illinois and then continued south. The UP conductor indicated that he and the engineer communicated signal indications to each other and that the trip was uneventful until they approached Rockview Interlocking and the crossing with the BNSF. The UP engineer told investigators that he was unable to recall anything about the trip after leaving Gorham (about 47 miles from Rockview).

Based on signal system data, head end video, the UP conductor's statements and the UP conductor's written log, the UP train encountered an Advance Approach (flashing yellow aspect) signal at MP 127.7. The next signal was displaying Approach (solid yellow aspect) at MP 129.0.

The next signal was displaying Restricting (flashing red aspect) at MP 131.1. The home signal of Rockview Interlocking was displaying Stop (solid red aspect) at MP 131.4.

The UP conductor said that on approaching the restricting signal at MP 131.1, he sensed that the train would not stop short of the stop signal at Rockview and he used the conductor's emergency brake valve to place the train into emergency braking. The UP train struck the passing BNSF train shortly thereafter. Impact speed was 43 mph based on event recorder data.

Figure 2: Aerial view of accident scene

Shortly after his arrival at the hospital emergency room, the UP engineer was contacted by a Missouri State Highway Patrol Sergeant. Investigators interviewed the Patrol Sergeant who said that when asked what happened, the UP engineer replied:

"Sir, I don't know. I remember Jimmy waking me up and we hit"

The Patrol Sergeant told investigators that both UP crew members showed no symptoms of impairment and appeared alert when he saw them at the hospital.

Operating Documents-UP

The UP crews were governed by the General Code of Operating Rules, 6th Edition, effective April 7, 2010 and updated as of April 23, 2013. The territory was designated the UP Northern Region, St. Louis Service Unit, Chester Subdivision. At the time of the accident, the current timetable was St. Louis Timetable No. 4, effective December 14, 2009.

The applicable supplements to the operating rules were:

- System Special Instructions – Dated 4/20/12 including updates as of April 23, 2013
- Air Brake and Train Handling Rules – Dated 4/20/12 including updates as of April 23, 2013
- Safety Rules – Dated 7/30/07 with revisions through 4/23/13
- System General Orders - Dated 4/23/13

Operating Documents-BNSF

The BNSF crews were governed by the General Code of Operating Rules, 6th Edition, effective April 7, 2010 and updated as of February 1, 2013. The territory was designated the BNSF Springfield Division, River Subdivision. At the time of the accident, the current timetable was Springfield Division Timetable No. 8, August 15, 2012.

The applicable supplements to the operating rules were:

- System Special Instructions No. 3 – Dated 7/18/12 with revisions through 5/1/13
- Air Brake and Train Handling Rules – Dated 4/7/10 with revisions through 5/1/13
- TY & E Safety Rules – Dated 10/30/05 with revisions through 11/1/12

Further, each train was issued track bulletins (BNSF) or track warrants (UP) for their respective Subdivisions that covered unique speed restrictions or other requirements specific to

the date of the accident. There were no special restrictions in the bulletins/warrants at Rockview Interlocking on either railroad.

Method of Operations

Trains on both railroads were governed and authorized by signal indication. The territories were operated under Traffic Control System (TCS) rules with the UP train dispatcher stationed at Omaha, Nebraska and the BNSF dispatcher stationed at Fort Worth, Texas. The train dispatchers set routes at control points to authorize train movements. Intermediate automatic block signals were located at intervals between control points and provided indications to train crews on the status of signal blocks ahead and of speed requirements. There were no automated signal system features in the accident area to enforce the requirements of the signal indications.

Maximum authorized track speed through Rockview Interlocking was 40 mph for UP trains and 25 mph for BNSF trains.

There were no scheduled passenger trains operated on the tracks where this accident occurred.

Signal Requirements Leading Up to the Impact Point

As the BNSF 4138 approached Rockview, signals displayed clear (green) indicating that the route was aligned and maximum speed was authorized.

As the UP 5668 approached Rockview, there were four signals that governed movement and provided information to the engineer in advance of the interlocking. Information on the four signals is provided in the table below.

Location	Aspect Display	Name	Indication
MP 127.7	Flashing Yellow	Advance Approach	Reduce to 40 mph prepared to stop at 2nd signal
CP D129	Solid Yellow	Approach	Reduce to 30 mph prepared to stop at next signal

CP D131	Flashing Red	Restricting	Reduce to Restricted Speed
Rockview	Solid Red	Stop	Stop

Table 3: Signals that were encountered by the striking UP train

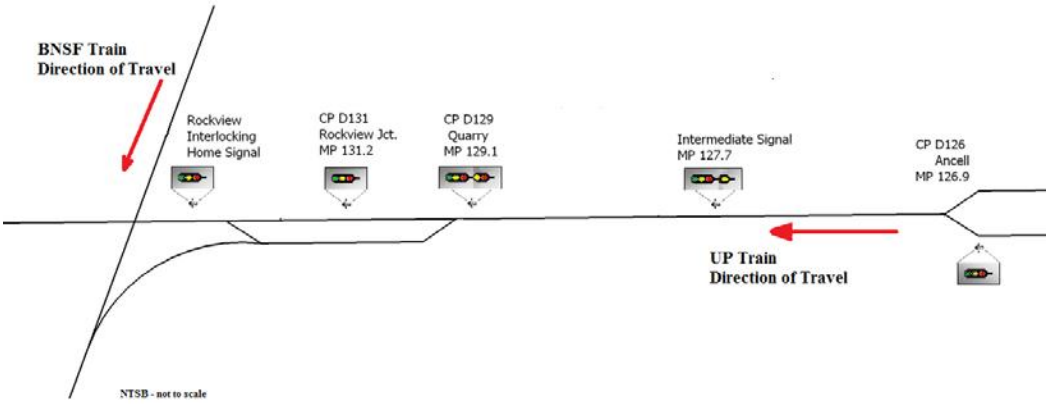

Figure 3: Diagram of UP Signals Approaching Rockview

Signal Rules - BNSF

A green aspect (clear) displayed on the Rockview signal allowed a train to operate through Rockview Interlocking at the maximum track speed of 25 mph. Event recorder data indicates that the actual speed of the struck train at the time of collision was 22 mph.

Signal Rules - UP

A flashing yellow aspect (advance approach) on the intermediate signal at MP 127.7 required a train to reduce speed to 40 mph and prepared to stop at 2nd signal. A solid yellow aspect (approach) on the signal at Quarry required a train to not exceed 30 mph and prepare to stop at the next signal. A flashing red aspect (restricting) on the signal at Rockview Junction required a train to operate at restricted speed. A solid red aspect (stop) on the Rockview home signal required a train to stop short of the signal. Event recorder data indicates that the actual speed of the UP train speed remained between 54 and 48 mph as it passed these four signals.

Restricted speed on the UP is defined in GCOR rule 6.27 as follows:

When required to move at restricted speed, movement must be made at a speed that allows stopping within half the range of vision short of:

- Train
- Engine
- Railroad car
- Men or equipment fouling the track
- Stop signal, or
- Derail or switch lined improperly

When a train or engine is required to move at restricted speed, the crew must keep a lookout for broken rail and not exceed 20 MPH.

Comply with these requirements until the leading wheels reach a point where movement at restricted speed is no longer required.

UP 5668 Crew Recollections

Both crew members on the UP train were interviewed 2 days after the accident and in a follow up interview conducted on August 28, 2013.

The UP engineer did not take any exception to the mechanical condition of the train. The UP conductor told investigators that the speedometer on the conductor's side of the cab was not working[4].

The UP engineer said that he could not remember anything about the trip after leaving Gorham (about 47 miles from Rockview). He described his first memory after the accident as follows:

[4] There was no report of the inoperative speed indicator found in UP maintenance records. The speed indicator was not tested after the accident due to post collision damage. A working speed indicator on the conductor's side is not required by FRA regulations.

> I remember riding on the train, calling out signals, and then after a while my memory fades out. And the next thing that I remember is the conductor leaning over me asking me if I'm all right. And I remember looking up at him and going, yeah. And I'm wondering why I'm laying down. And he had said that we'd been in an accident. And I said, oh. He helped me up.

The engineer was shown preliminary event recorder data that was downloaded from his train after the accident. When presented with a train speed of 54 mph several minutes at 2:25 a.m., (or about five minutes before the collision) in an area where the train should have been travelling not more than 30 mph under approach signal conditions and preparing to slow further, the engineer said that he should not have been "going that fast." The engineer was unable to offer any explanation as to why the locomotive horn was activated in an area where the horn was not required to be blown, why the horn was not activated at the last road crossing, and why there were numerous horn activations immediately before impacting the BNSF train. The engineer was questioned as to whether he fell asleep before the accident, to which he responded, "I don't know."

During the follow up interview, the engineer said that he still could not remember the final part the accident trip. He indicated that he had spoken with several medical practitioners describing his memory lapse and he now surmised that he had a "diabetic blackout".

The UP conductor said that the engineer appeared normal and alert to him. He said that they called out signals aloud. He could not recall who called the signals first. He described passing the approach signal:

> When we passed the approach, I asked him what our speed was and he responded, "30-something." So I assume that's -- he's under control, he's doing what he has to do. At an approach, that signal is solid yellow, reduce speed to 30, be prepared to stop at the next signal. I had no reason to believe that that's not what we were doing.

He went on to explain that he did not notice anything out of the ordinary until they got closer to the interlocking:

> I was writing in my logbook. I saw that the signal, the absolute signal, at the north end was approach. I called it out. Engineer repeated it back to me. I was writing in my logbook, doing what I have to do as a conductor, my duties, talking on the radio, doing what I had to do. Nothing was out of the normal. It's an everyday thing we've done there, you know, and there's a sweeping curve to the right, when you're heading south, and there's the signal is at the south end. We came around the corner; I saw that we had a restricting. I didn't think we were slowing down like we should. I plugged the train like I was trained to do. That's about all I remember.

The conductor explained in the subsequent interview that he was engaged in writing the entries in his log between the approach signal and the point where he pulled the conductor's valve to apply the emergency brakes:

> I think the only time I looked at him was when I asked the speed at the approach. I don't recall looking at him ……. I had my head down looking in my – you know, writing in my book. When I looked up, that's when I realized we were going faster than at that point than we had been.

When questioned as to whether he believed that the engineer was asleep at that point, the conductor responded, "No. I don't think so." He also was asked whether he perhaps nodded off at that point, and he responded no, that he was "…pretty busy doing what I have with my job to do," and, "There's a lot going on in that little bit of time."

The conductor's log indicates the name of the less than clear signals they encountered along with the time and speed. The conductor's log sheet is attached as Attachment 1. The distance between the approach signal and the restricting signal was 10,291 feet. The Rockview home signal was 1,215 feet from the restricting signal.

UP 5668 Event Recorder Information

The advance approach signal was about 3 ½ miles in advance of the stop signal at Rockview. Event recorder information indicates that the UP train speed remained between 48 and 54 mph over the 4 miles approaching Rockview. About 47 seconds before the collision, UP 5668 was travelling at 49 mph, at throttle position 4. About 24 seconds before the collision, UP 5668 throttle position was reduced to 3. About 18 seconds before the collision, emergency braking was activated. At this time, the train was travelling at 49 mph.

At 02:28:21 CDT, the time of the collision, UP 5668 was travelling at about 43 mph.

UP Crew Communication Requirements Leading up to the Collision

UP General Code of Operating Rules 1.47 C "Duties of All Crew Members" requires the following:

> **C-1 Crew Members in Control Compartment**
> Crew members in the control compartment must communicate to each other any restrictions or other known conditions and required actions that affect the safe operation of their train sufficiently in advance of such condition to allow the engineer to take proper action. If proper action is not being taken, crew members must remind engineer of such condition and required action.
>
> Crew members in the control compartment must be alert for signals. Crew members must:
> Crew members must be alert for signals. Crew members must:
>
> - Communicate clearly to each other the names of signals affecting their train as soon as sibnals become visible or audible.
> - Continue to observe signals and announce any change of aspect until the train passes the signal.
> - Communicate clearly to each other the speed of the train as it apsses a signal with an indication other than clear.

- Immediately remind the engineer of the rule requirement if the singal is not complied with.

C-2. Radio Transmission

Except when switching a crew member must transmit the engine number, direction, location and signal name (include track number in multiple main track CTC territory) when the head end of the train:

A. Passes a signal that requires:

Or,

B. Stops for a signal that requires stopping.

However, instructions may be issued to identify locations where this radio transmission is not required.

C-3 Proper Action

If engineer and/or conductor fail to comply with a signal indication or take proper action to comply with a restriction or rule, crew members must immediately take action to ensure safety, using the emergency brake valve to stop the train, if necessary.

Additionally, UP GCOR 1.47.1 establishes a cab red zone when a train operates on a signal requiring being prepared to stop at the next signal or when operating at restricted speed. UP GCOR describes a cab red zone as follows:

During a cab red zone, an environment must be created in the control compartment that focuses exclusively on controlling the train and complying with the rules. The conductor must be in the control compartment unless required by other duties to leave (i.e. to operate switches, be at a road crossing, passenger train duties, etc.).

The following restrictions or conditions must be met:

- Cab communication is restricted to immediate responsibilities for train operation.

- A crew member other than the employee operating the controls will be required to handle radio communications when another crew member is in the control compartment except when operating with manned helper(s), Rule 33.6.1 (Operating Responsibilities with Manned Helper). Radio communication must be limited to the train's immediate movement and complying with the rules (road crossing protection, Form B instructions, etc.).
- If proper action is not being taken, crew members must remind each other of the cab red zone condition.

Sight Distance Observations

On the night of May 28, 2013, investigators conducted sight-distance observations to determine the farthest possible distance where an operating crewmember on a UP train could visually identify the aspects of the last 4 signals approaching the accident site. Weather and lighting conditions during the sight distance observations were similar to that at the time of the accident.

Investigators boarded a locomotive at UP Illmo Yard (Scott City, MO) that was similar to the lead locomotive on the striking train. The locomotive was operated by an engineer and conductor who were qualified on, and familiar with, the territory. The signals were set to display the same aspects as on the morning of the accident. The operating crew was instructed to note when they could first determine the aspect displayed on each of the four signals leading up to the accident location. The locomotive distance counter was used to measure the sight distance to the four signals. Observation results are summarized in the table below:

Observable Aspect	Engr. Sight distance[5]	Cdr. Sight distance
Advance Approach signal MP 127.7	3,749 feet	3,714 feet

[5] Due to track curvature, signals may become visible on one side of the cab before the other side.

Approach signal CP D129	7,097 feet	7,097 feet
Restricting signal CP D131	4,403 feet	4,315 feet
Rockview Stop Signal	4,702 feet	4,702 feet

Table 4: Sight Distance Measurements

Medical and Toxicology

Engineer of UP train: The UP engineer passed his most recent company physical examination, which included a vision and hearing test to operate as an engineer, on July 20, 2012. During his interview, the engineer told investigators that he has been a diabetic since 1997 and that he believed the railroad was aware of that diagnosis.

Conductor of UP train: The UP conductor passed his most recent company physical examination on May 14, 2010. He described his health as good.

Engineer of BNSF train: The BNSF engineer passed his most recent company physical examination, which included a vision and hearing test to operate as an engineer, on December 12, 2011.

Conductor of BNSF train: The BNSF conductor passed his most recent hearing test on January 27, 2012. He initially underwent and passed a pre-employment physical examination on August 21, 2003.

The Safety Board's Medical Officer received and examined the UP's medical records of the UP crewmembers involved in this accident. A medical factual report will be submitted to the docket as a separate report.

Pursuant to 49 Code of Federal Regulations (CFR) 219, Subpart C, Post-Accident Toxicological Testing, toxicological specimens were obtained from the engineers and conductors of the BNSF and UP trains. Substances screened for included cannabinoids, cocaine, opiates, amphetamines, methamphetamines, phencyclidine, barbiturates, benzodiazepines, and ethyl alcohol. The results were negative for the presence of alcohol and the aforementioned drugs. In addition, the four crewmembers were administered a breath analyzer test to determine the presence or absence of alcohol. No alcohol was detected.

Employee Information

Train Dispatchers

The UP train dispatcher was hired in May 1997 as a trackman. He became a train dispatcher in 2001. He was qualified on the territory involved in this accident had recently bid to the desk covering the accident area about 3 ½ weeks before.

The BNSF train dispatcher was hired as a dispatcher in January 2011. He was qualified on the territory involved in this accident had worked the desk since June 2012.

Train UP 5668 Crew (Striking Train)

UP Engineer: The engineer was hired as a brakeman on the Chicago Eastern and Illinois Railroad in April 1974[6]. Records indicate he began working as a thru freight locomotive engineer out of Salem, Illinois in 1980. He has operated out of Salem for most of his career. Records indicate that he was territory qualified at the time of the accident. His last check ride was in November 2012. He successfully passed a stop signal test on May 22, 2013.

UP Conductor: The conductor was hired as a conductor in October 2008. He has operated regularly out of Salem, Illinois since May 2011. His last check ride was in August 2012. His successfully passed a stop signal test on December 30, 2012.

Train BNSF 4138 Crew (struck train)

BNSF Engineer: The engineer was hired into train service in January 1997. Records indicate that he worked as a conductor, brakeman or switchman at various locations on the BNSF system until 2003. In 2004 he began working as a locomotive engineer in Gainesville, Texas. He has worked out of Chaffee, MO since June 2008. Records indicate that he was territory qualified at the time of the accident. His last check ride was in March 2013 and his performance score was 98 out of 100.

[6] This was a subsidiary of the Missouri Pacific Railroad. The Missouri Pacific was later acquired by the Union Pacific.

BNSF Conductor: The conductor was hired as a conductor in September 2003. He worked most of his career out of Springfield, MO, transferring to Chaffee in June 2012. He had operated over the accident territory since January 2012. Records indicate that he was territory qualified at the time of the accident. His last recertification as a conductor was on June 21, 2011.

Inspection and Testing of Signal System

A postaccident inspection of the signal system found all signal bungalows and signal equipment locked and secured with no indications of tampering. Each signal location was downloaded. FRA recreated vital codes in and verified each aspect to display as intended and as well as vital codes out. Ground tests did not indicate any exceptions. Signals lenses were inspected and no defects were noted. Circuit plans were reviewed and all associated junction boxes inspected.

There were no defects noted to the signal system or associated appurtenances during these inspection activities. Maintenance, inspections and test records were reviewed and were in accordance with FRA requirements.

Data from the signal system and the defect detector on the UP train movement was downloaded and reviewed. Signal data was consistent with the signal aspects and indications as presented in table 4 above. The data from the defect detector at MP 128.0 indicated that the train passed at an average speed of 55 mph and that no defects were detected. This detector scans for hot bearings and dragging equipment.

Crew Schedules

UP Engineer Schedule: Time sheets indicated the following data on the UP engineer's work schedule over a several day time period before the accident:

Date	On Duty	Off Duty	Time On Duty
May 19	1:15 a.m.	1:08 p.m.	11 hours, 53 minutes
May 22	3:00 a.m.	2:08 p.m.	11 hours, 52 minutes
May 23	1:05 p.m.	9:35 p.m.	8 hours, 30 minutes

May 24	9:45 p.m.	2:30 a.m. (May 25 – accident occurs)	4 hours, 45 minutes[7]

Table 5: UP Engineer's Recent Work Schedule

During his interview on May 27, 2013, the UP engineer said that he was unable to recall the times he awoke and retired on Wednesday, May 22. He also was unable to recall when he awoke the following day, Thursday, May 23, but did remember that he worked, went off duty at 9:35 p.m. and retired for the evening between 11:00 p.m. and 11:30 p.m. He awoke the following day, Friday, May 24 at 7:30 a.m., had coffee, checked train line-ups via his computer, had breakfast and remained home. He recalled the he napped from about 1:00 p.m. until 4:00 p.m., had dinner at 7:30 p.m. and went on duty at 9:45 p.m.

At the time of the accident the UP engineer had been on duty for 4 hours and 45 minutes, and, based on his recollections, had been awake for about 10 hours and 30 minutes.

UP Conductor Schedule: Time sheets indicated the following data on the UP conductor's work schedule over a several day time period before the accident:

Date	On Duty	Off Duty	Time On Duty
May 19	11:55 p.m.	7:55 a.m. (May 20)	8 hours
May 21	7:30 a.m.	3:00 p.m.	7 hours, 30 minutes
May 23	12:15 a.m.	9:52 a.m.	9 hours, 37 minutes
May 23	11:00 p.m.	3:21 a.m. (May 24)	4 hours, 21 minutes
May 25	9:45 p.m.	2:30 a.m. (May 25 – accident occurs)	4 hours, 45 minutes

Table 6: UP Conductor's Recent Work Schedule

During his interview on May 27, 2013, the UP conductor said that he was unable to recall when he awoke and retired on Wednesday, May 22. Likewise, he was unable to recall this same information for the following day, Thursday, May 23. He recalled that he went off duty at 3:00 a.m. on Friday, May 24, and retired between 3:30 a.m. and 4:00 a.m. He slept until noon, showered, had dinner, was called for duty at 6:45 p.m., and went on duty at 9:45 p.m.

[7] As of the time of the accident at 2:30 a.m.

At the time of the accident the UP conductor had on duty for 4 hours and 45 minutes and, based on his recollections, awake for about 14 hours and 30 minutes.

BNSF Engineer Schedule: Time sheets indicated the following data on the BNSF engineer's work schedule over a several day time period before the accident:

Date	On Duty	Off Duty	Time On Duty
May 18	12:01 a.m.	11:35 p.m.	11 hours, 34 minutes
May 19	11:05 a.m.	7:50 p.m.	8 hours, 45 minutes
May 23	12:30 p.m.	12:35 a.m. (May 24)	12 hours, 5 minutes
May 24	7:00 p.m.	2:30 a.m. (May 25 – accident occurs)	7 hours, 30 minutes

Table 7: BNSF Engineer's Recent Work Schedule

During his interview on May 26, 2013, the BNSF engineer stated that he was off duty Wednesday, May 22 and Thursday, May 23.[8] On that Wednesday he arose at about 7:00 a.m. and retired between 9:00 p.m. and 10:00 p.m., and arose about 7:30 a.m. and retired about 9:00 p.m. that Thursday. On Friday, May 24, he arose about 9:15 a.m., watched television, had something to eat, napped for about 30 minutes between 11:00 a.m. and 11:30 a.m. and went on duty at 7:00 p.m.

At the time of the accident the BNSF engineer had been on duty for about 7 hours and 30 minutes and based on his recollection, with the exception of a brief nap, been awake for approximately 17 hours and 15 minutes.

BNSF Conductor Schedule: Time sheets indicated the following data on the BNSF conductor's work schedule over a several day time period before the accident:

Date	On Duty	Off Duty	Time On Duty
May 18	12:01 a.m.	11:35 p.m.	11 hours, 34 minutes
May 19	11:05 a.m.	7:50 p.m.	8 hours, 45 minutes
May 21	9:15 a.m.	9:00 p.m.	11 hours, 45 minutes
May 22	9:45 a.m.	11:55 a.m.	2 hours, 10 minutes
May 23	12:30 p.m.	12:35 a.m. (May 24)	12 hours, 5 minutes

[8] Time sheets confirmed that the engineer did work on Thursday, May 23 for the clock times indicated.

May 24	7:00 p.m.	2:30 a.m. (May 25 – accident occurs)	7 hours, 30 minutes

Table 8: BNSF Conductor's Recent Work Schedule

During his interview on May 26, 2013, the BNSF conductor recalled that he awoke at approximately 8:00 a.m. on Wednesday, May 22, deadheaded[9] to and arrived at Chaffee, MO by 1:15 p.m., traveled home at retired at 10:00 p.m. He awoke the following day, Thursday, May 23 at 6:45 a.m., worked from about 12:15 or 12:30 p.m. until 12:30 a.m. the following day, Friday, May 24 and retired at 2:00 a.m. He awoke later that day at about 9:00 a.m., went to the gym, had something to eat at 3:00 p.m., returned to his room, and slept for 2 or 3 hours until he was called at 5:30 p.m. for a 7:00 p.m. on duty time.

At the time of the accident the BNSF conductor had been on duty for about 7 hours and 30 minutes and, based on his recollection, been awake for about 9 hours.

Inspection and Testing of Mechanical Condition of Trains

BNSF Train

A pre-departure mechanical inspection and brake test was performed at Kansas City, Kansas on May 23, 2013. No exceptions were noted on the brake test report.

UP Train

A pre-departure mechanical inspection and brake test was performed at Salem, Illinois at 2115 hours on May 24, 2013. No exceptions were noted on the brake test report.

A post-accident mechanical inspection and brake test was performed on the rolling stock. The FRA report on the mechanical condition of the UP train indicated that it was in compliance with FRA regulations and did not contribute to the accident. The crash worthiness inspection determined the lead locomotive cab performed as intended and furnished a survivable environment for the crew.

[9] Time sheets indicated he was on duty for two hours and ten minutes from 9:45 a.m. until 11:55 a.m.

UP Management Oversight

Efficiency Testing

The Code of Federal Regulations (CFR) contains specific requirements[10] for the testing and observations of operating employees while they perform their duties. The UP maintained an operational testing program to monitor the performance and rules compliance of the employees operating trains on the UP system[11]. The CFR also contains additional testing requirements that railroads must adhere to regarding certification locomotive engineers including a requirement that locomotive engineers who operated on signaled track be tested once per year on a "less than clear" aspect[12].

The UP provided data for the engineer and conductor of the striking train involved in the collision. The records indicated cover the 12 months preceding the accident. Supervisors had performed a variety of operational tests involving those employees. A summary of the overall testing is provided in the table below:

Category	Engineer	Conductor
Total test events[13]	22	18
Total individual tests	56	63
Total individual rules checked	128	169
Test events on Chester Sub	5	6
Test events at Rockview	1	0

Table 9: Summary of Operations Tests Performed on UP crew

[10] **CFR 49 Part 217.9 Program of operational test and inspections; recordkeeping.** …Each railroad to which this part applies shall periodically conduct operational tests and inspections to determine the extent of compliance with its code of operating rules, timetable, and timetable special instructions….."
[11] *UP Field Training Exercise Program Managers' Guide* Effective December 1, 2012
[12] **CFR 49 Part 240.129 Qualification and Certification of Locomotive Engineers … "**compliance with provisions of the railroad's operating rules that require response to signals that display less than a "clear" aspect"
[13] A test event my involve more than one individual test and more than one individual rule

Several of the tests outlined in the UP FTX manual relate to procedures relevant to this accident. Testing data on those tests are summarized below:

Test Num.	Test	UP Eng.	UP Cdr.
1A	Stop test	4	3
3A	Stop signal	7	8
3B	Restricted proceed	0	1
4	Restricting	0	0
5A	Approach/Approach Diverge	0	0
5B	Signal less than clear	0	0
8	Speed limit	1	1
11A	On board assessment	10	10

Table 10: Selected Operations Tests Performed on UP crew

Data on the testing that UP managers conducted on the crew of the UP train during the 12 months preceding the accident show three test results listed as below standard for the UP engineer. No tests on the conductor were listed as below standard. The three below standard test events on the engineer involved (1) headlight left on dim while train was tied down, (2) ditch lights not properly displayed, and (3) failure to have a copy of the system General Orders. The engineer was coached following each of these events.[14]

Weather and astronomical conditions

The closest National Weather Service reporting site to the accident site was Cape Girardeau Regional airport, Cape Girardeau, Missouri, located approximately 5 miles northeast of Chaffee, Missouri. The airport had an Automated Surface Observation System and reported the following conditions:

> Cape Girardeau weather at 0153 CDT on May 25, 2013, automated observation, wind calm, visibility unrestricted at 10 statute miles, sky clear, temperature 48° F (8.9° C), dew point temperature 44° F (6.7° C), altimeter 30.29 inches of mercury. Remarks: sea level pressure 1025.6-mb.

[14] UP FTX guide describes 3 outcomes from testing: (1) pass, (2) below standard – coach, and (3) below standard – additional handling.

A review of observations indicated no rain fall within the last 24 hours and there was no significant weather. The synoptic conditions indicated that the area was under a ridge of high pressure during the period.

The astronomical conditions as reported by the United States Naval Observatory indicated the Moon rose at 1950 CDT on May 24, 2013 with the Moon transit at 0100 CDT on May 25, 2013, and set at 0608 CDT. The phase of the Moon was a waxing gibbous with 100% of the Moon's visible disk illuminated. The full Moon occurred on May 24, 2013 at 2326 CDT.

North America experienced a lunar eclipse on the evening of May 24, 2013, where the moon passed into the Earth's outer shadow or penumbra. The maximum eclipse occurred at 2311 CDT on May 24, 2013, and lasted 33 minutes between 2254 to 2327 CDT. At which time 1.6% of the Moon's visible disk was in the eclipse.

Highway bridge information

Missouri State Route M travels through western Scott County Missouri from Interstate Highway 55 west to the western county line near the communities of Rockview and Chaffee. The highway is generally oriented east and west in the accident area.

The Route M highway bridge over the BNSF/UPPR diamond at grade crossing was designed and constructed in 1988. The structure was listed in MODOT's records as structure Number A4376 and had Federal Number 3576 in the National Bridge Inventory. It was located at highway Station No: 102+29.48. The structure had five spans supported by two abutments and 4 intermediate column bent assemblies. The approach spans were pre-stressed concrete, pre-cast 4-beam girders that were 62 feet long each on the west side of the bridge and 58 foot-long each on the east side of the bridge. The main span had 66-inch deep rolled steel 4-beam girders that were 125 feet long. The bent caps had concrete diaphragms which the girders were connected to. Both bents next to each abutment were steel pipes filled with concrete. Each was 60 feet long with 30 foot embedment depth. Both were comprised of six steel columns. There were three concrete columns at bents 3 and 4. Each column was 36-inches in diameter and embedded to a depth of 41 feet below the footings.

Figure 4: Derailed cars and damaged bridge supports

Bent No. 3 was sheared off at the base of the footing by the train impact after the derailment. This loss of structure allowed spans 2 and 3 to collapse. The downward vertical movement of these spans was stopped by the wreckage of the derailed train cars underneath the structure. Photographs showed there were several UPRR Auto-rack carrier cars that came to rest against the fractured columns of bent No. 3. Also, oval shaped impact damage was found on BN Car No. 30230 that was 42-inches wide and 39 inches deep. The shape of the damage was consistent with impact into one of the bent columns. This car number was car 22 in the BNSF train consist, 10 cars behind the impact area, which occurred at 12 cars behind the rearmost locomotive. The vertical clearance between the track elevation and the bottom of the girders was approximately 24.5 feet. The horizontal clearance from the center of the rails to bent No. 3 was

21 feet 9 ¾ inches. There was not a crash protection wall shielding the bents from impact with railroad equipment.

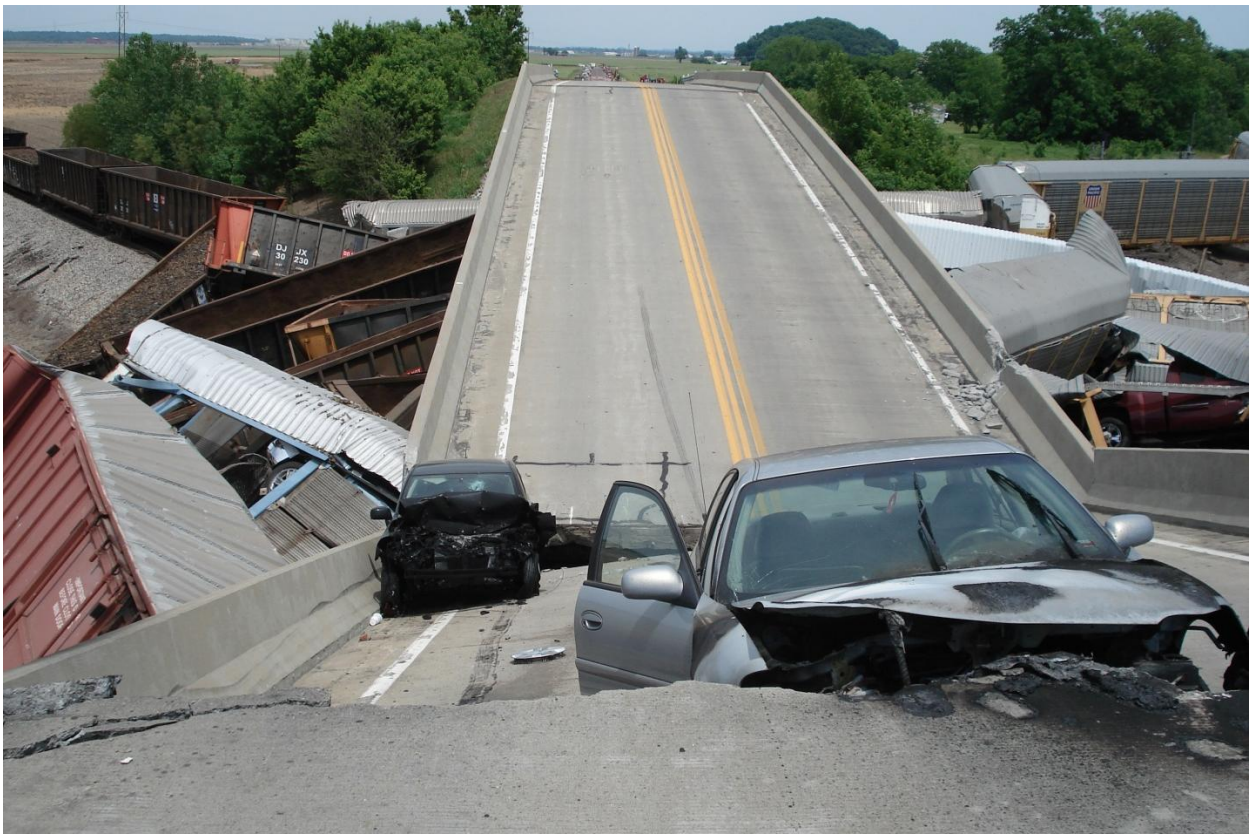

Figure 5: Collapsed bridge deck

Bridge No: AA4376 was subject to the FHWA required bridge inspection standards. It was last inspected on February 25, 2013. The deck and substructure were rated as satisfactory and the superstructure was rated as good. A special inspection was performed on the bridge on January 30, 2013 following a BNSF derailment that occurred on the evening of January 29th, 2013. The inspector noted that bent No. 3 had been struck in that derailment as well. The inspector noted the impact only caused light scraping and paint marks on the concrete bent with no structural damage.

The American Railway Engineering and Maintenance-of-Way Association (AREMA) had the following 2005 design guidelines in their 2012 edition. Crash walls or piers of heavy

construction are recommended for piers if the horizontal clearance from the centerline of the rails to the piers is less than 25 feet.

American Railway Engineering Association (AREA) guidelines in their 1986 edition were in place when this bridge was designed and constructed. AREA guideline 2.1.5 for Concrete Pier Protection Construction did not define heavy construction in the 1986 edition that applied to this bridge. AREA is the predecessor organization to AREMA.

Missouri DOT (MODOT) documents related to pier protection were also examined. MODOT bridge design and construction specifications had detailing construction for pier protection walls but no warrants on when they were to be used. The Federal Highway Administration (FHWA) was also contacted regarding pier protection requirements for highway bridges over railroads. FHWA indicated that since these public structures were being constructed on private railroad property under the authority of easements granted by the railroad that warrants and specifications specified by the railroad or AREMA would be the governing documents.

Postaccident Actions

Missouri Department of Transportation

As a result of this accident and the earlier BNSF derailment, the Missouri Department of Transportation incorporated crash walls in the new design for Highway M bridge that provided approximately 600 kips of resistance to impact forces. The equivalent 600 kip static load is based on information obtained from crash testing an 80,000-pound truck into a concrete structure at 50 mph. The redesigned and reconstructed bridge is shown in figure 6.

Figure 5: New Highway M Bridge

BNSF Railroad

The BNSF conducted safety briefings with all crews on the Springfield Division where the accident was discussed.

Union Pacific Railroad

The UP issued an Incident Alert to all train and engine service employees on the UP system after the accident that referenced rules crews should focus on and provided a general description of the incident so that crews and managers would be aware of what happened. The rules referenced were: Rule(s) to Review: 1.1.2 (Alert and Attentive), 1.47 (Duties of Crew Members), 1.47.1 (Cab Red Zone), 6.27 (Movement at Restricted Speed), 9.12.2 (Manual

Interlockings), 70.3 (Job Briefing). The Incident Alert was also posted on the Operating Practices Incident Alert page of the UP employee website.

--- End of Factual Report ---

Party Spokespersons have reviewed and verified the accuracy of this report

Fred Pringle, FRA	Tom Beardslee, Scott County, MO
Randy Dumey, BLE&T	Randy Eardensohn, UPRR
Ken Edwards, UTU	Joe Lair, MO DOT
Rance Randle, BNSF	Tim Tarrant, BRS