RAILROAD SIGNAL & TRAIN CONTROL GROUP
FACTUAL REPORT OF INVESTIGATION

Train Collision of
Union Pacific Railroad and
BNSF Railway in
Chaffee, Missouri on
May 25, 2013

DCA-13-MR-004

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RAILROAD, PIPELINE &
HAZARDOUS MATERIALS INVESTIGATIONS
WASHINGTON, D.C. 20594

A. ACCIDENT

LOCATION:	Chaffee, Missouri
TRAIN 1:	Southbound train 2ASMAR-25
OPERATOR:	Union Pacific Railroad
TRAIN 2:	Southbound train U-KCKHKM0-05T
OPERATOR:	BNSF Railway
DATE:	May 25, 2013
TIME:	2:30 a.m.
NTSB #:	**DCA-13-MR-004**

B. SIGNAL & TRAIN CONTROL GROUP

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C. SYNOPSIS

Figure 1. Arial view of accident scene.

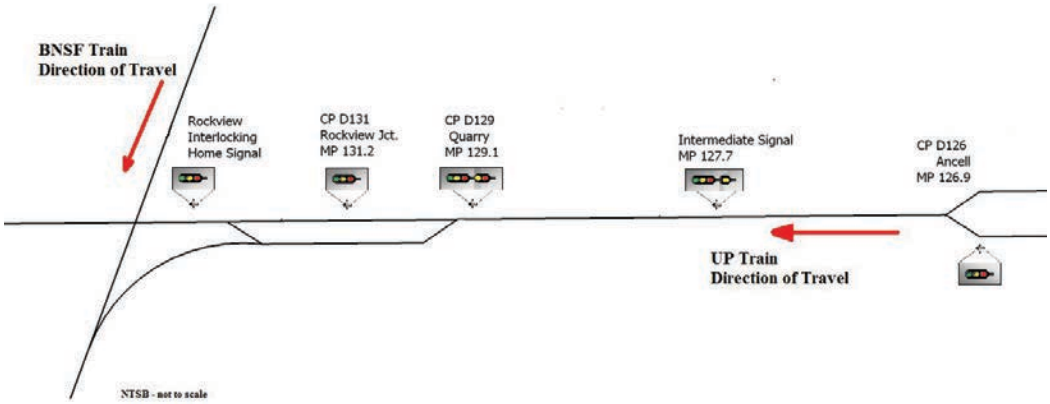
On May 25, 2013 at approximately 2:30 a.m., central daylight time[1], near Chaffee, Missouri, Union Pacific (UP) southbound freight train, 2ASMAR-25 collided with BNSF southbound[2] freight train U-KCKHKMO-O5T, where UP and BNSF tracks cross at Rockview interlocking. The BNSF train was occupying the 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. Missouri State Highway M Bridge is 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 and were involved in fires. Five occupants of the motor vehicles were transported to a local hospital. It was clear and 48° F at the time of the accident. The preliminary damage was estimated to be in excess of $8 Million.

[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.

D. DETAILS OF THE INVESTIGATION

1. Description of Railroad Signals



1.1 UP Railroad

The UP, St Louis Service Unit, Chester Subdivision extends from East St Louis, Illinois to Dexter, Missouri in a timetable north-south direction. The maximum authorized timetable speed on the subdivision is 70 mph for freight trains with a 40 mph restriction through the Rockview Interlocking. In the vicinity of the accident area, the UP operates over a single main track utilizing a Traffic Control System (TCS) controlled by a dispatcher located at the Harriman Dispatch Center located in Omaha, Nebraska. Train movements on the Chester Subdivision are governed by UP Railroad operating rules, timetable instructions, and the signal indications of the signal system.

The intermediate signal at MP 127.7 is controlled by a Harmon Industries Electro-code 4 Plus unit and a Safetran color light signal utilizing colored lenses and incandescent bulbs with an upper three position head capable of displaying a green, yellow, and red aspect, and a lower single position head capable of displaying a yellow aspect. The CP Quarry signal is controlled by a Union Switch and Signal (US&S) Microlok 2 vital logic controller, and is equipped with a US&S M-23A power operated switch machine, and Safetran color light signals utilizing light emitting diode heads with an upper three position head capable of displaying a green, yellow, and red aspect, and a lower two position head capable of displaying yellow or red aspect.

Rockview interlocking is located near Chaffee, Missouri at milepost (MP) 131.4. Rockview is a manual interlocking, controlled by a General Electric Transportation Systems

(GETS) Vital Logic Controller, and equipped with US&S M-23A power operated switch machines, and Safetran color light signals utilizing colored lenses and incandescent bulbs. Operating in a southbound direction on the main track approaching the Rockview interlocking, two signals are encountered. The first (No. 8 signal) was installed in preparation for a crossover switch to the siding track which was not installed and is a single three position head capable of displaying a green, yellow, and red aspect. The second (No. 4 signal) is also a single three position head capable of displaying a green, yellow, and red aspect.

Both UP and BNSF dispatchers send controls to Rockview interlocking. To line a signal to operate over Rockview interlocking, the railroad wanting to move a train must send a request to the field equipment. The other railroad dispatcher will receive an indication on his terminal that the first railroad has requested a signal and will send a control to acknowledge the request. This can be accomplished by both railroads at the same time and in that situation; the first train to occupy the approach track circuit to the interlocking will receive a signal to operate over the railroad crossing.

Operation and control of the Rockview interlocking signal system is accomplished by the UP with two signal control bungalows. The first is referred to as the master bungalow and houses all data logs for the interlocking. The second is referred to as the slave bungalow and is located in close proximity to the BNSF control bungalow in the geographic northwest quadrant of the railroad crossing. The slave bungalow was destroyed along with the BNSF bungalow as a result of the collision.

1.2 BNSF Railway

The Rockview interlocking is located on the BNSF River Subdivision of the Springfield Division at MP 141.7. Through this area the BNSF operates over a single main track utilizing a TCS system and controlled by a dispatcher at the Network Operations Center located in Fort Worth, Texas. Train movements on the River Subdivision are governed by BNSF Railway operating rules, timetable instructions, and the signal indications of the signal system. The River Subdivision extends from St Louis, Missouri to Turrell, Arkansas in a timetable north-south direction. The maximum authorized timetable speed on the subdivision is 55 mph for freight trains with a 20 mph restriction from MP 142.5 to MP 143.

The intermediate signal at MP 139.7 is controlled by a GETS Electracode 5 controller and a Safetran color light signal utilizing colored lenses and incandescent bulbs with a single three position head capable of displaying a green, yellow, and red aspect.

2. Postaccident Data Logs

UP dispatchers monitor and coordinate train movements utilizing the signal system. Field signal and train control equipment maintain logs of signal data locally and also transmit the data to the UP dispatch center where it is displayed on the dispatcher's terminal. The UP dispatch center computer clocks are synchronized to UTC time so the dispatcher clock time was used to synchronize all wayside field recorders to a common time reference. Table 1 summarizes signal and train control events recorded for CP Quarry (D129) and CP Rockview Junction (D131) at the UP dispatch center.

Table 1. *UP dispatch center postaccident signal and train control data log*

Time	CP	Event
2:18:31	D129	Southbound signal 14 requested clear by dispatcher
2:18:31	D131	Southbound signal 8 requested clear by dispatcher Southbound signal 4 requested clear by dispatcher
2:18:39	D129	Southbound signal 14 indicates clear
2:18:39	D131	Southbound signal 8 indicates clear BNSF interlocking home signal indicates clear
2:24:21	D129	North track circuit 1 indicates occupied by Train 2ASMAR-25
2:25:42	D129	Switch indicates normal OS circuit indicates occupied by Train 2ASMAR-25 Southbound signal 14 indicates at stop
2:25:50	D131	Track circuit 11 indicates occupied
2:25:52	D131	BNSF interlocking home signal indicates at stop Interlocking OS indicates occupied by Train U-KCKHKM0-05T
2:27:02	D129	North track circuit 1 indicates unoccupied
2:27:14	D129	OS circuit indicates unoccupied
2:28:02	D131	Switch indicates normal OS circuit indicates occupied by Train 2ASMAR-25 Southbound signal 8 indicates at stop
2:28:02	D131	Switch indicates normal OS circuit indicates occupied by Train 2ASMAR-25

Table 2 summarizes signal and train control events recorded at the intermediate signal at MP 127.7. Table 3 is the data from CP Quarry (D129) and Table 4 is the data from CP Rockview Junction (D131).

Table 2. S*ignal and train control data from intermediate signal 1277*

Time[3]	**Codes**	**Events**
1:48:39	1,4,5 received from CP Quarry	Indicates flashing yellow aspect being displayed at intermediate signal for UP train
2:14:51	No codes	Indicates UP train in advance of intermediate signal

Table 3. S*ignal and train control data from CP Quarry*

Time[4]	**Event**
2:18:42	• Request for southbound signal • Route cleared • A-head is cleared • Red aspect off • AS goes down • Lock relay down • Code 2 to the north drops • Code 4 to the north goes out • Code 2 to the south drops
2:24:21	• Southbound yellow signal energized on A-head • Southbound red signal energized on B-head
2:25:46	• Request drops • Route drops • A-head no longer cleared • Southbound head, red repeater indicates up • OS down • Code 4 to the north drops • Northbound A-head, red • Northbound B-head, red • Northbound C-head, red • Northbound D-head, red • Southbound yellow signal de-energized • Southbound red signal energized on A-head
2:25:58	• AS indicates up

[3] Intermediate signal 127.7 clock time was 42 minutes behind the dispatch clock.
[4] CP Quarry clock time was 33 days, 6 hours and 15 minutes behind the dispatch clock.

2:27:15	• OS indicates up • LOS indicates up • Code 2 out to the north • Code 2 out to the south on main track • Signal goes dark, train off circuit

Table 4. S*ignal and train control data from CP Rockview Junction*

Time[5]	**Event**
2:21:28	Southbound signal cleared
2:25:57	Southbound signal indicates flashing red
2:27:57	OS circuit indicates occupied by BNSF train
2:28:11	North OS circuit indicates occupied
2:28:25	OS circuit indicates occupied by UP train
2:28:31	Slave house struck during collision

In addition to wayside signal data, downloads from the previous three defect detectors encountered by the UP train were acquired. Table 5 summarizes the data from the defect detectors.

Table 5. D*ata from defect detectors for UP train*

Time[6]	**Location**	**Train Speed**	**Train Length**	**Defects**
1:56	Ware (D105-1)	53 mph	5631 ft	No defects
2:11	Gail (D917-1)	55 mph	5624 ft	No defects
2:25	Quarry (D928)	55 mph	5574 ft	No defects

County Road 209 crosses the UP main track at MP 131.10. The highway-rail grade crossing is equipped with an active warning system. The data log from the grade crossing system indicated the UP train went through this crossing at 2:25:11 at a detected speed of 47 mph.

Additional data was collected from the BNSF signal system. Table 6 summarizes the data from the NOC. Table 7 is the data from the BNSF approach signal to the Rockview interlocking.

Table 6. BNSF *network operations center postaccident signal and train control data log*

[5] CP Rockview Junction clock time was 8 minutes behind the dispatch clock.
[6] Times based on individual defect detector clock and were not synchronized with signal system clock.

Time	Event
2:21:20	North approach track circuit indicates occupied by BNSF train Southbound interlocking home signal indicates clear
2:22:21	North approach track circuit indicates occupied by UP train
2:28:04	Rockview interlocking and OS circuit at CP Mayes indicates occupied by BNSF train
2:43:04	Rockview interlocking and CP Mayes both indicate code fail

Table 7. *Signal and train control data from BNSF intermediate signal 139.7*

Time	Codes	Event
2:21:53	5, 7 from CP Rockview Junction	Indicates green aspect being displayed at intermediate signal for BNSF train
2:24:17	No codes	Indicates BNSF train in advance of intermediate signal

3. Postaccident Signal System Inspection and Testing

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, BNSF, UP and MO-DOT 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 during these inspection activities to the signal system or associated appurtenances. Maintenance, inspections and tests were in accordance with FRA requirements.

FRA performed a hy-rail inspection. The inspection began just north of CP Ancell, MP 125.9 and included measuring distances from signal mast to signal mast (in the direction of the UP southbound train) approaching the accident area.

After passing CP Ancell, intermediate signal 127.7 was encountered and measured 11,137 feet. There were no obstructions identified that could have interfered when the signal was visible. CP Quarry signal at MP 129.1 measured 7,164 feet from the intermediate signal. There were no obstructions identified that could have interfered when the signal was visible.

The signal encountered at CP Rockview Junction (signal No. 8) measured 10,291 feet from CP Quarry. The Rockview interlocking home signal (signal 4) measured an additional

1,215 feet beyond signal 8. There were no obstructions identified that could have interfered when the signal was visible.

As a result of the collision, signal damages were estimated at $500,000.

END OF S&TC FACTUAL REPORT